ROADS AND STREETS

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Highway Beautification With CWA Labor

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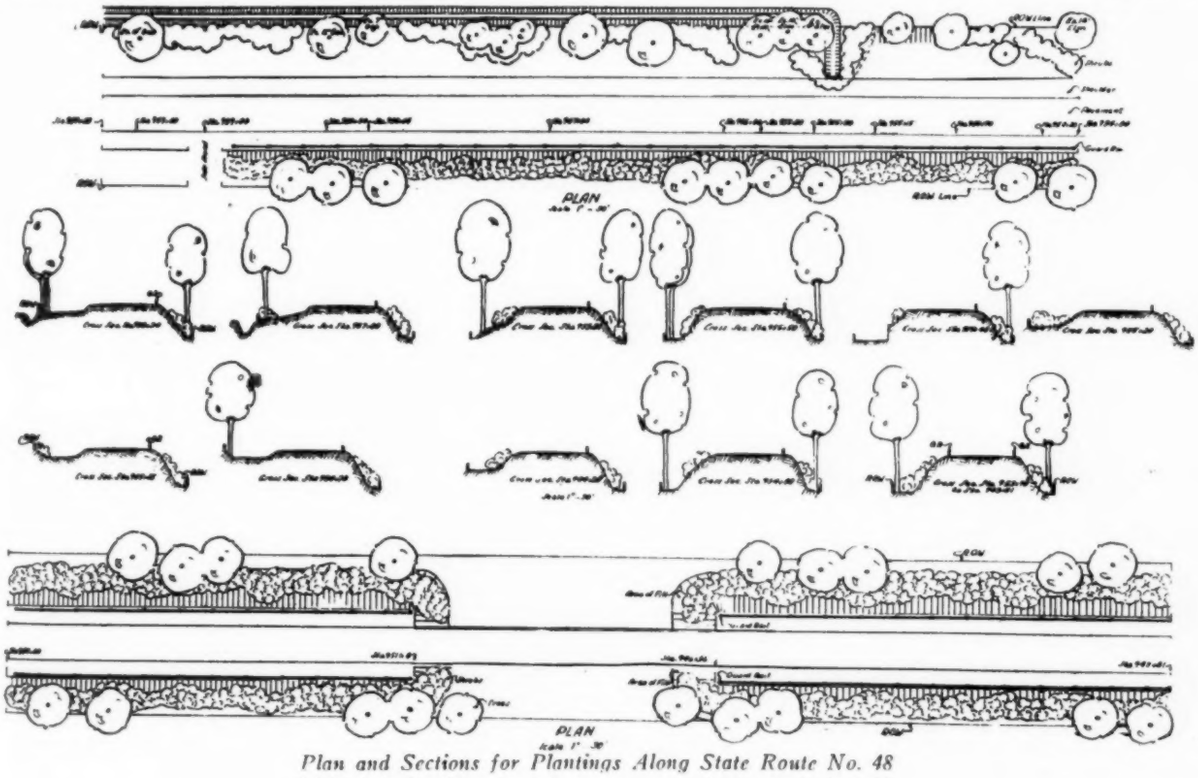
THE primary object in the construction of the highways of the state of Illinois, was to accommodate traffic, but now that we have one of the best highway systems in the world, much interest is being shown in the further development of these highways by appropriate plantings of trees and shrubs, or in other words "highway beautification."

In view of this widespread interest in highway beautification and with an appreciation of the fact that a large portion of the traffic over the highways is pleasure driving that seeks the most beautiful routes, John W. DeBrun, Jr., made application through the CWA for a landscape project for State Route 48, this project to extend some 28 miles from the county line at Harvel to the county line northeast of Stonington. The application was approved and the project granted; the CWA to supply the labor and the state of Illinois to supply the plant material consisting of trees, shrubs and vines.

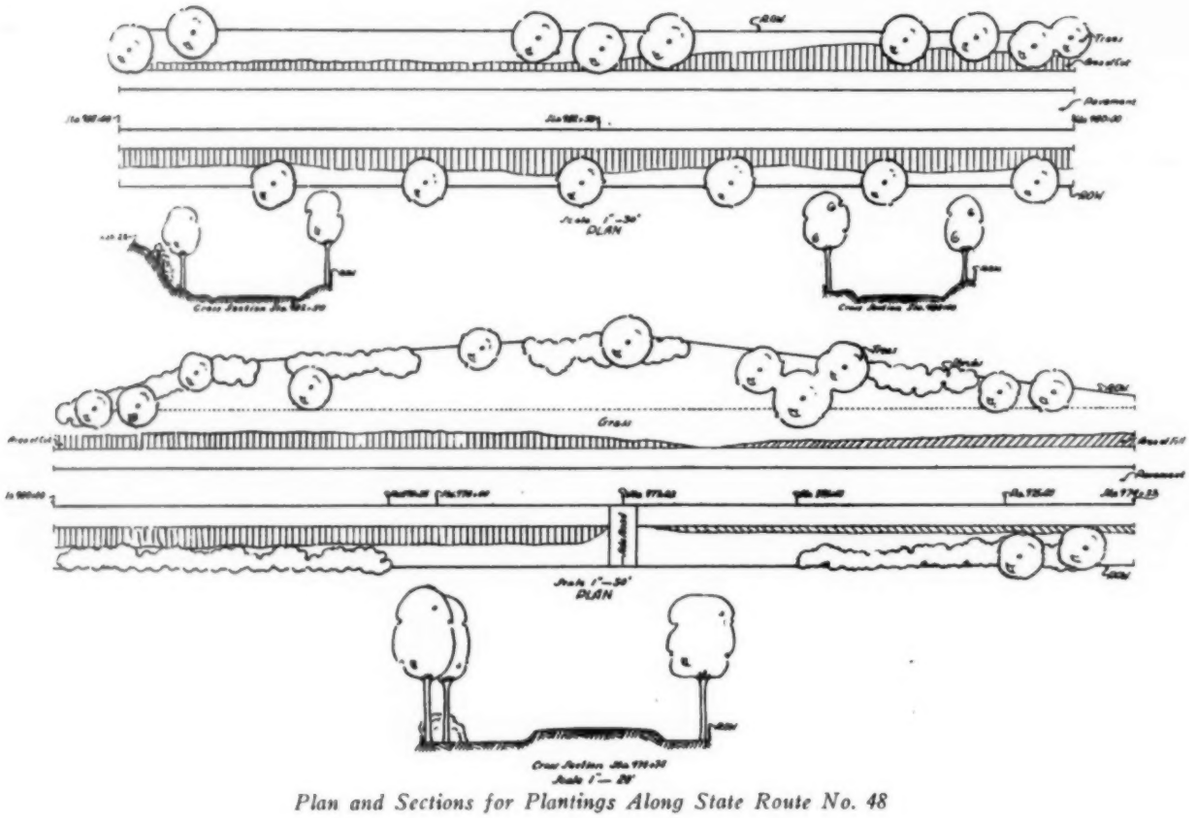
State Route 48, with a minimum Right of Way of 80 ft. presents an ideal opportunity for beautification, or the planting of trees and shrubs and the seeding and sodding of shoulders, cuts and fills.

Preliminary Studies.—This development is not for a year or a decade, but for generations and a thorough study of this stretch of highway was made so that the many factors necessary for an appropriate planting could receive proper consideration. The planting when completed, will not hide approaching traffic, cause snow drifts to form, or interfere unduly with adjoining farmland. The planting is so designed that it need not be disturbed, should the pavement be widened to 40 ft. in the future. Co-operative relations have been established with public utility companies, so as not to interfere with existing power or communication lines.

The various types of soil along this highway and the selection of varieties of trees and shrubs adapted to this



Plan and Sections for Plantings Along State Route No. 48



Plan and Sections for Plantings Along State Route No. 48

soil received consideration and the type of planting appropriate for the particular section was determined.

Definite plans were made, dividing this stretch of highway into sections or units and the plantings of the sections so blended into each other to express unity of idea over the whole distance of the project.

Selection of Trees and Shrubs.—The varieties of trees and shrubs used, wherever possible, are native material adapted to the location and type of soil. Several varieties of tall growing trees, such as American Elm, Sycamore, Sugar Maple and Norway Maple are being used, with the American Elm predominating. Where overhead power or communication lines are encountered, round headed varieties of trees are used, as they will not interfere with these lines.

The contour of the surrounding country and the character of the highway determines to a large extent the type of planting for the various sections. But about two miles through the South Fork section, once known as "Hell's Half Acre," consisting of uneven rolling country, the planting will be entirely informal or natural. Through this section much grading of the right of way was necessary to smooth out the unsightly rough places and the low wet places left by the contractor have been drained, so that the entire section may be planted. All tall growing trees as well as the low growing varieties will be planted in groups. The fill on both sides of South Fork Ridge has been planted with Coralberry. At the base of this planting are groups or drifts of native Sumac and Red Dogwood, with a series of Sycamore trees planted in groups. Vines and suitable ground cover will cover the space between the shrub planting and the Guard Rail. The several deep cuts will be planted with groups of low growing trees such as Wild Crab, Flowering Dogwood and Red Bud. The upper face of the cuts will be planted with low growing native shrubs such as Coralberry, hazel brush, sumac, rosa setigera, etc. Below the shrubs, the face of the cuts will be planted with attractive vines and ground covers and the lower part seeded to grass or sodded. At several places through this section the Right of Way widens for several hundred feet. These places afford an opportunity of developing miniature parks which will give shade and beauty.

In addition to making this section one of the most beautiful drives in Central, Ill., this planting of shrubs and trees will keep the soil from washing and give lower maintenance costs for years to come.

Another informal planting similar to the South Fork will be made in the Bear Creek Section near Morrisonville. The other sections of the project are to be given semi-formal or formal treatment.

This project was started the middle of December and when completed there will have been planted about 4,000 treees and some 75,000 shrubs. At the present time about 1,000 trees and 7,000 shrubs have been planted, and several thousand shrubs have been collected and are on hand for planting as soon as the weather permits.

The work is under the direct supervision of John W. Debrun, Jr., of the Division of Highways, State of Illinois. Martin H. Seiler, Landscape Architect, is in charge of the designing and planting, and Leon Drummond is in charge of the collection of Native Material.

The State of Illinois has the finest highway system in the world and it is to be hoped that such project as the development and beautification of State Route 48 through Christian County, is merely a start, and that the work will be carried on throughout the entire state.

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Large Highway Bridge to Be Built in Germany.—In connection with the construction of a 75-mile highway from Munich, Bavaria to the Austrian border at Salzburg, a new bridge will be built over the river Inn at Pfraundorf. The bridge will be a 2-track structure 875 ft. long and 76 ft. wide. Construction on the highway has been started.

Snow Fighting Through A Transcontinental Pass

AN account of how snowfalls rivaling those of the Alps have been conquered by maintenance forces of the U. S. Bureau of Public Roads in the fight to keep winter traffic moving over U. S. Highway No. 40 through Berthoud Pass in Colorado was given in a talk by Clyde E. Learned, Senior Highway Engineer of the Bureau, before the Highway Conference at Boulder, Colo., January 18, 1934. During the past two winters the Bureau of Public Roads crews, with generous contribution by the Colorado State Highway Department, have battled annual snow falls of 40 ft. on a 30-mile section of the transcontinental highway straddling the pass between Empire and Fraser, Colo.

The road through the pass crosses the Continental Divide at an elevation of 11,306 ft. above sea level. At this great height there is snow during eight months of the year. As early as October and as late as May falls of 3 or 4 ft. may be expected; and March and April—the months of heaviest fall—bring deposits of 12 ft. and more. During the season of 1932-33 there were 84 storms, the individual falls ranging from 1 to 96 in.

Snow Removal Considered in Design and Location.—The present road through the pass was built by the Bureau of Public Roads between 1920 and 1933. On the old road, narrow and crooked with steep grades and poor exposure, the open season was only about four months. As sections of the new road were completed the season was gradually extended; and for the past two years there has been year-round service.

Contributing to this striking accomplishment there has been a lot of hard work, of which the removal of the fallen snow is the most obvious and the most glamorous. But back of the more active removal work; beginning, in fact, with the construction of the road, a lot of quiet preparatory work has been done that has eased considerably the still man-sized job of the snow fighters.

Even, indeed, before the road was built there was thought of the eventual job of snow removal and measures were taken to make the job as easy as possible. In the location and design of the highway the grades were raised wherever possible above the surrounding land so that the winds sweeping across them, would tend to keep the highway clear. In some places the line was run deliberately through wooded areas for protection against drifts; in others the plans called for thinning or clearing of adjacent timber to obtain better exposure to sun or wind.

On steep mountain slopes the roadway was set as far out from the mountain side as possible, cutting, on the inside, wide, shallow ditches to catch sliding snow. In through cuts similar wide, shallow ditches were dug on both sides of the road to provide storage space for snow removed from the traveled way; and the cut banks were flattened to minimize snow slippage and improve exposure.

Another foresighted provision was made in the construction of deep, intercepting ditches and underdrains to cut off and collect surface and ground water and prevent it from forming dangerous ice mats on the road surface.

The purpose of these measures taken during the construction of the road is to enlist nature as an ally in the

Top of Berthoud Pass. Every Sunday and Holiday 300 to 600 People are Skiing, Snowshoeing and Tobogganing in this Area. Note Snow Fence in Foreground.

snow fight, and employ natural forces and laws to reduce as greatly as possible the difficulties of the work.

Drift Prevention Measures Taken.—Of somewhat similar character are the steps taken to prevent increase of the snow removal burden by drifting. Installations of snow fence are the means employed for this purpose. The preferred form is the flexible slat and wire type that comes in rolls and is easy to install and handle. This fence is 4 ft. high, and near the top of the pass it has been erected to a height of three tiers or 12 ft., the second and third installations being made as the sections below are buried. Difficulties with drifts are encountered on only 5 or 6 miles of the 30-mile

Tractor with 15-ft. Push Plow on Top of Berthoud Pass Cleaning Up After 4-ft. Snow Storm.

section. Elsewhere adjacent timbered regions have given protection; and consideration is being given to the possible planting of trees in the drift areas to provide permanent snow barriers and reduce the need for snow fences.

Snow Fighting Organization Picked Men.—All such measures materially reduce the task of removal; but they still leave it a job that demands the best there are of men and machines. The men are carefully picked from the regular maintenance organization. They are familiar with the road, are physically fit to endure the long hours and discomforts of blizzard battling, and can be depended upon to be courteous to the traveling public. They are housed in comfortable quarters and provided with the most modern snow-fighting equipment and facilities for its protection and care.

Snow Removal Equipment.—Snow-removal equipment used during the past two years includes two 5-ton, 4-wheel drive trucks equipped with front-mounted, reversible, steel plows, and two tractors, of 35 and 70 h.p., both equipped with reversible steel plows. The larger plow is 15 ft. long and 4 ft. deep, and capable of clearing a wide path as it moves along the road. For handling deep, piled snow a heavy-duty, truck-mounted, rotary plow of auger and fan type is available. All the plows are reversible since the snow on this road usually must be disposed of on the mountain slopes below the highway.

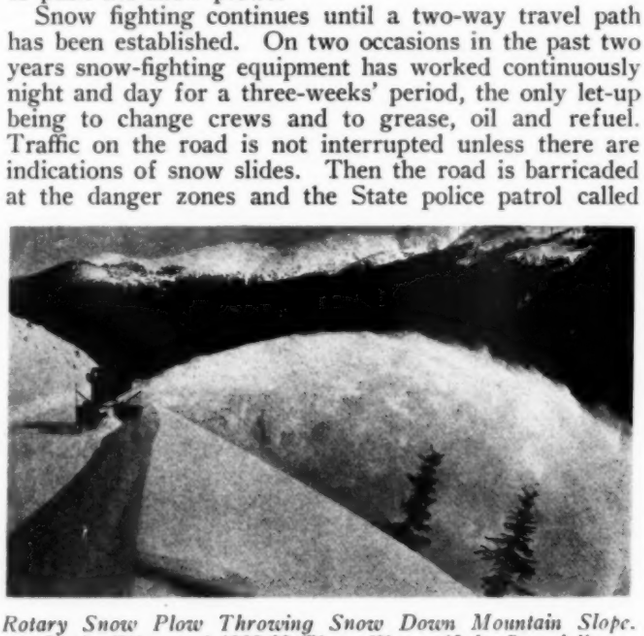
Snow Fighting Methods.—Snow-fighting methods change as the season advances. Up to the middle of January the snow is thrown clear over the outside edge of the road using the fast-moving, heavy-duty trucks. A small windrow or mount of snow is left along the outside edge of the road to define the margin and guide the motor vehicle driver at night. As the winter advances, this outside windrow grows larger and larger. By March it has grown up to a height of from 5 to 10 ft. and of considerable width depending on the steepness of the side slopes. This mound of snow at the side makes it practically impossible for a motorist to drive off the road.

The snow does not roll down the mountain side when pushed over the edge of the road, as one might expect, except where the road has a sheer drop at the side. Ordinarily, the snow piles up beyond the edge of the road after the snow on the ground has reached a depth of 4 to 5 ft. As the adhesion of the snow causes it to build up at a much steeper angle of repose than that of the road embankment, the snow beyond the edge of the road very soon accumulates to a considerable height and in a place where it cannot be reached by the push plows.

When conditions reach this stage, snow-fighting tactics are changed and a rotary plow is used to clear a width 22 to 26 feet on the highway, the snow being thrown some distance away.

The method of fighting a snow storm under such conditions, when the push plows cannot shove any more snow off the roadway, is as follows: The high-speed trucks pile the snow in a windrow near and along the outside windrow which was established to aid motorists. The slower-moving rotary plow goes into action as soon as the truck plows accumulate enough snow in this secondary windrow to be handled economically. The snow in the windrow is thrown from 50 to 100 ft. away from the road, usually down hill but always with the wind. When the snow falls so rapidly that it gets too deep for the truck plows to operate effectively, tractors are used to push the snow plows.

Snow fighting continues until a two-way travel path has been established. On two occasions in the past two years snow-fighting equipment has worked continuously night and day for a three-weeks' period, the only let-up being to change crews and to grease, oil and refuel. Traffic on the road is not interrupted unless there are indications of snow slides. Then the road is barricaded at the danger zones and the State police patrol called



Rotary Snow Plow Throwing Snow Down Mountain Slope. In the Winter of 1932-33 There Was a 42-ft. Snowfall.

into service. Snow plows are equipped with powerful search lights but in intense storms it is often necessary for a man to walk a few feet ahead of the truck or tractor to direct its movements and to keep it on the road.

Costs of Snow Removal.—To determine the unit costs of operation, a trial test of 14 days' duration was made of the auger type rotary snow plow in March, 1932. In 73 hours of actual operation the plow moved 93,400 cu. yds. of windrowed or partially packed snow weighing 17.3 lbs. per cubic foot. Total operating costs of the rotary plow were $400, including a rental of $3.14 an hour charged against the plow.

The unit cost of moving the snow was 0.4 ct. per

cubic yard, equivalent to 2½ cu. yd. of windrowed snow or 7 cu. yd. of new snow for 1 ct., or 1¾ ct. per ton.

The snowfall of the winter of 1932-33 was handled at a cost of $14,838. To keep the 30 miles of road through Berthoud Pass open, the average cost per inch of snowfall was $42. Of this cost, labor was 30 per cent, material and supplies 20 per cent, repairs 7 per cent, and rentals 43 per cent. Between 3,000,000 and 4,000,000 cu. yd. of new snow has been moved with all types of equipment each winter for the past two years at a cost of less than ½ ct. per cubic yard.

It is evident from these figures, that the cost of keeping open the 30-mile section of road across Berthoud Pass is around $15,000, or $500 a mile, including all labor, materials, supplies and equipment rentals.

The economy of keeping Berthoud Pass open, without considering the convenience to the public, can be estimated from the traffic counts and the revenue derived from the gasoline taxes. With 53,000 vehicles using the Pass during the 8 months in which it would be closed but for the snow-fighting operations, the gasoline tax alone represents an income of at least $25,000, which is almost twice the cost of snow removal necessary to keep the highway open.

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Ohio Good Roads Federation Celebrates Silver Anniversary

The Ohio Good Roads Federation celebrated its 25th anniversary on Jan. 15. An interesting account of the meeting is given by Prof. F. H. Eno in the February issue of Engineering Experiment Station News of Ohio State University, from which the notes following are taken:

Secretary George Rudisill gave the history of the Federation. He told of the five incorporators, George W. Lattimer, Manley M. Maxwell, William Hager, Arch Huston, and Julius F. Stone. Of these, only two, Stone and Huston, are living. Both were present.

Most of the road laws since 1911 have either been written by the Federation or have had its support. In 1911 the Federation and James Marker, then Highway Commissioner, laid out the inter-county highway system which has since been followed and completed. The Federation started in 1924 the issue of detour maps, an activity that was later taken over by the State Highway Department.

Directors of the Department of Highways (the title was formerly Commissioner) have been: Sam Huston,* 1905-07; James C. Wonders,* 1907-11; James Marker, 1911-15; Clinton Cowan,* 1915-19; A. R. Taylor, 1919-21; Leon C. Herrick, 1921-23; L. A. Boulay, 1923-25; George Schlesinger, 1925-28; Harry Kirk, 1928-29; Robert Waid, 1929-31; O. W. Merrell, 1931-.

Of those still living, all except two, Herrick and Schlesinger, were present at the luncheon.

Mr. Marker gave a reminiscent account of road work in Ohio from 1907 to 1915. His best story was how Ohio in 1912 scooped nearly one-quarter of the first Federal appropriation for road aid.

When the Federal appropriation was made, it was specified that each state could obtain $10,000 if it would put up two dollars for each Federal dollar. Many states were so tied up by their laws that they could not enter into this arrangement.

Jim Marker and the Ohio Good Roads Federation talked it over and decided to send a committee to Washington to see what could be done to get Ohio's share of the money. The committee consisted of Marker, Arch Huston, and Jesse Taylor. At the Bureau of Public Roads they found that eleven states had been unable to meet the requirements for the Federal aid. The extra $110,000 could be had for the asking. The committee had no authority to promise more than the $20,000 to get Ohio's $10,000, but the opportunity was too good to miss. On sheer nerve they asked for the whole $120,000, and promised to put up $240,000 to match it. They had a plan to raise that money.

Returned to Ohio, the three conspirators convassed Licking and Muskingum counties, asking for subscriptions on the ground that for every two dollars contributed the Government would give one dollar, and the money would be used to build a concrete pavement on the National Road, now Route 40, through those counties. The money was raised, and Ohio obtained twelve times her share of that first Federal aid appropriation.

It was the beginning of the highway expansion in Ohio.

Director Merrell called attention to the rapid evolution of transportation from state to rail, then to highways, and later to aviation. He prophesied a greater growth in highways in the next five years than ever before. The great highway problem now, he said, is not construction but reconstruction.

Secretary Alsdorf predicted that there would be available for road work in Ohio for 1934, $20,000,000, plus three or four million which may be returned by the State from past transfers of road funds. The Public Works Administration has allocated about $5,000,000 in the state, and may expend $40,000,000 more during the year.

Other speakers were ex-Senator Hudson, ex-Director Boulay, and Charles Duncan, secretary of the Ohio Contractors' Association.

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Indiana Starting Its 1934 Construction Program

With bids for highway and bridge construction work having an estimated cost of nearly $2,500,000 to be received by the State Highway Commission during latter part of February, employment for hundreds of men during the spring and summer months will be available. Every effort will be made to start construction as soon as weather conditions permit.

The first bids on the program opened by the Highway Commission on Feb. 20, included the erection of 12 bridges, an overhead crossing and repairs to a bridge. These projects have an estimated cost of over $300,000 and are located in seven counties. On Feb. 27, the Commission opened bids on 31 highway projects scattered through 25 counties and having an estimated cost of over $2,000,000. This work includes work on highway routes through eight cities to be financed with federal funds; paving, grading and the widening of culverts and small structures.

On the eight city street projects being financed with federal funds, the wage and labor provisions of the National Recovery Act will apply. These provisions set a minimum wage of 50c an hour. On the remaining work, to be financed with state funds, the state regulations will apply. The state regulations provide for a minimum wage of 50c an hour with a 30-hour week.

This construction program is a part of that planned for 1934 by the State Highway Commission and plans are under way for receiving bids on other projects which will provide considerable additional employment in communities where the work is located.

* Deceased.

Scientific Research and Future Road and Street Building Programs

By A. A. POTTER

Dean of Engineering, Purdue University

THAT Indiana has not been backward in its support of highway transportation is evidenced by the fact that this state has expended for road building alone, not counting Federal contributions, over 300 million dollars since 1919; the disbursements of the State Highway Commission alone having totaled over 185 million dollars since 1919.

Thanks to your effective work the roads of Indiana are a source of pride to all. We are certain that in rain or shine, winter or summer, our good roads make motor vehicle transport safe and comfortable.

In watching the Indiana road building program during the past 14 years, I have been wondering as to whether you who are responsible for the design, construction, and maintenance of highways and streets are making sufficient use of new science and are planning your future programs with a degree of certainty. This matter has been called most forcefully to my attention during recent weeks when, in my capacity as a member of the National Science Advisory Board for the Railroads, it was necessary for me to appraise the methods used by industries, outside of transportation, to plan for the future. I found that the most successful industries of this country have been spending for research, even during the past four year of depression, 1 to 4 per cent of their income in order to keep ahead of practical applications. I found that the Bell Telephone Laboratories have appropriated last year (1933) over 13 million in research and development, of which 8½ million were expended for fundamental scientific research in order to appraise the effect of new developments which come from the outside. The Aluminum Company of America has been devoting to research 1 to 4 per cent of its gross sales; the DuPont 1½ to 4 per cent of its net income. Apparently industries which have best weathered the depression have been foremost in research, as they consider research expenditures as the insurance their companies must take out in order that their products may continue to show improvement year by year.

What percentage of the 25 or more billion dollars which have been expended in this country during the past fourteen years for roads and streets, or of the 350 million or more dollars which have been used in road building in Indiana during the same period has been utilized to develop better methods of road building by taking advantage of new science? What encouragement are you giving to the development of new types of roads and streets to take care of increased demands? What knowledge, accurate scientific knowledge, has the State Highway Department and other road building agencies of Indiana and of the Nation, which they can use most effectively in their plans for the future, so that the funds available for road building may be employed most beneficially to the public? What new knowledge are you gathering about road construction which insures that you are basing your programs for the future upon facts and not merely upon opinions? Are your present methods of building roads sufficiently flexible to allow for traffic growth? Expenditures by progressive industrial enterprises are supported by facts secured through research. Is that true in road building? We have in this country not less than three million miles of improved roads and over three-fourths million miles of hard surface roads. We have not reached the saturation point in road and street building but what scientific knowledge have you to guide construction in the future in order to make certain that you are building better roads year by year? What guarantee are you giving the taxpayers that obsolescence on your roads will not be excessive?

Your Purdue University has received from industry since 1925, or during the past eight years, $1,278,500 for engineering research of value to American industry. This does not include the Purdue Research Foundation or agricultural research. To name a few of the contributors to engineering research: The railroads, $946,000; the Indiana Limestone interests, $23,000; the Electric and Gas Public Utilities, $168,000; and for television research, $101,000. How much has been expended by the State or by the nation during the same period, since 1925, for highway research? Taking even the low figure of 1½ per cent on expenditures, and most progressive industries spend 3½ or 4 per cent for research, more than five million dollars should have been expended since 1925, or during the past 8 years by Indiana for highway research. While I have no accurate figures of such research expenditures, I am certain that it was much less than one-tenth. Can we expect true progress in road building under such conditions?

It is true that no single improvement has done more in recent years for the general good of the people of Indiana than the improvements in our streets and highways, but what of the future? Research for such an important undertaking as road building is like insurance for you individually. You must substitute the certainty for the uncertainty by devoting more money to highway research or you are bound to lose public support.

It has been said that the research program of a company is a guide to the investment value of its securities. One of these days you will find that the taxpayer will demand accurate research knowledge if he is to invest large sums in improved roads and streets.

Acknowledgment.—The foregoing is an abstract of a paper presented at the 20th Annual Purdue Road School.

Progress on Public Works Highways

Progress made on emergency construction of public works highways to Feb. 24 under the supervision of the U. S. Bureau of Public Roads shows a total of 6,265 projects, estimated to cost $318,119,000, had been advertised for contract or begun by day labor employed directly by the highway authorities. The cost of the day labor projects included in the above is estimated at $22,926,000.

Of the 5,476 projects awarded for construction, 3,654 were under construction on Feb. 24, and 681 were completed. The work under construction, which is estimated to cost $212,826,000, was giving regular employment to 125,649 men.

Code of Fair Competition for the Construction Industry

The first chapter of the long awaited code of fair competition for the construction industry became effective on March 2. It was signed by President Roosevelt on Jan. 31. There will be but one code for the entire industry. The code effective on March 2, known originally as the basic code of the construction industry, becomes Chapter I of the one code. Chapter I applies to all divisions and must be observed in conjunction with the chapter for the specific division of the industry. According to the present plan Chapter II will be the code for general contractors and under it there will be supplemental codes: Chapter II-A code for building contractors: Chapter II-B code for heavy construction and railroad contractors; Chapter II-C code for highway contractors; and so on for other supplemental codes for various subdivisions of general contractors. There also will be other chapters with codes for engineers, architects, and subcontractors. Chapter II has been completed and at this writing is ready for the President's approval.

PURPOSES

TO effectuate the policies of Title I of the National Industrial Recovery Act, the following provisions are established as a Code of Fair Competition for the Construction Industry, and shall be the standard of fair competition for this industry and shall be binding upon every member thereof.

CHAPTER I—GENERAL PROVISIONS*

Article I. Application

The provisions of this Code shall apply to the entire industry as hereinafter defined, excluding operations therein undertaken in accordance with bona fide bids made not more than sixty (60) days prior to the effective date, or contracts entered into prior to the effective date; except that the provisions of each chapter incorporated in this Code shall apply only to the division or subdivision of the industry defined in such chapter. In the case of conflict between such chapter provisions and the general provisions of this Code, the chapter provisions shall govern. If any other code of fair competition or a provision thereof, heretofore or hereafter approved by the President, shall conflict with this Code or with any provisions thereof, the Administrator may hold such hearings as he may deem necessary and thereafter may, if in his judgment justice requires, grant such stay, exception or exemption, or make such other determination as he may deem advisable to effectuate the policies of the Act.

Article II. Definitions

Section 1.—Construction Industry†

The term "construction industry" or "the industry" as used herein shall include the designing and the constructing of (and the installing and the applying, including the assembling at the site, of manufactured parts and products incorporated in and to):

(*a*) building structures, including modifications thereof and fixed construction accessory thereto, intended for use as shelter; and other

(*b*) fixed structures and other fixed improvements and modifications thereof, intended for use in industry, commerce, sanitation, transportation, communication, flood control, power development, reclamation and other similar projects or services; and such related divisions or subdivisions thereof as may be defined in chapters hereof, and included hereunder with the approval of the President.

Section 2.—Divisions of the Industry

The term "division of the industry" or "division" as used herein shall mean a branch of the industry which has been or may hereafter be defined in a particular chapter of this Code. The term "subdivision of the industry" or "subdivision" shall mean a defined section of a division.

Section 3.—Member of the Industry

The term "member of the industry" as used herein includes any individual or form of organization or enterprise engaged in any phase, or undertaking to perform any of the functions of the industry as defined in Section 1 hereof either as an employer or on his own behalf, including also but without limitation, architects, engineers, contractors and subcontractors.

Section 4—Member of the Division

The term "members of the division" or "member of the subdivision" includes any member of the industry engaged in one of the divisions or subdivisions of the industry now or hereafter established.

Section 5.—Employee

The term "employee" as used herein shall include any person engaged in any phase of the industry, however compensated, but excluding members of the industry.

Section 6.—Employer

The term "employer" as used herein includes anyone by whom any such employee is compensated or employed.

Section 7.—President, Act, Administrator

The terms "President," "Act," and "Administrator" as used herein shall mean, respectively, the President of the United States, the National Industrial Recovery Act, and the Administrator of Title I of said Act.

Section 8.—Effective Date

The term "effective date" as used herein shall mean the thirtieth (30th) day after the approval of this Code by the President, provided that in respect of a particular division an earlier effective date may be specified in the chapter applicable to such division.

Section 9.—Sponsors

The term "sponsors of the Code" as used herein means the following national associations of members of the industry which have applied for the approval of this Code and signified their assent thereto:

1. Construction League of the United States.
2. American Institute of Architects.
3. American Society of Civil Engineers.
4. Associated General Contractors of America.
5. International Society of Master Painters and Decorators, Inc.
6. Heating, Piping and Air Conditioning Contractors National Association.
7. Cement-Gun Contractors Association.
8. National Building Granite Quarries Association.
9. Contracting Plasterers International Association.
10. Tile and Mantel Contractors Association of America.
11. National Association of Master Plumbers of the United States.
12. National Elevator Manufacturing Industry.
13. Roofing and Sheet Metal Industries Conference.
14. Mason Contractors Association of the United States and Canada.
15. American Road Builders Association.
16. National Association of Metal Furring and Lathing Contractors.
17. Asbestos Contractors National Association.
18. National Association of Building Trades Employers.
19. National Association of Builders Exchanges.
20. American Construction Council.

and such other national associations of members of the industry as shall in like fashion hereafter sponsor additional chapters of this Code.

Section 10.—This Code

The term "this Code" as used herein shall mean and include, unless the context clearly indicates otherwise, all chapters from time to time included herein, together with any modifications or amendments thereto.

*Applies to all divisions of the construction industry and must be observed in conjunction with the Chapter for the specific division of the industry.

†Captions to Articles and Sections, where omitted in the official draft, have been added by the Construction League to assist the reader.

Section 11.—Population

Population, for purposes of this Code, shall be determined by reference to the 1930 Federal Census.

Article III. Hours, Wages, and Conditions of Employment

Section 1.—Mutual Agreements

In each division or subdivision of the industry, as defined in the chapter incorporated in this Code relating thereto, truly representative associations or groups of employers and employees respectively concerned, after proper notice and hearing and as a result of bona fide collective bargaining, may establish by mutual agreement (when approved by the President as provided in Section 7 (*b*) of the Act), for a specifically defined region or locality the standards of hours of labor, rates of pay and such other conditions of employment, relating to occupations or types of operations in such division or subdivision, as may be necessary to effectuate the policy of Title I of the Act. For the purposes of this Section, the entire United States may be defined as a region. The terms of such an agreement between the employers and employees of a division or subdivision of the industry shall not be binding upon the employers and employees of any other division or subdivision of the industry.

After the President has approved any such agreement arrived at within any such division or subdivision, and after proper notice of such approval, it shall be deemed prima facie unfair competition for any employer in such division or subdivision to fail to comply with the standards of maximum hours of labor, minimum rates of pay or other conditions of employment so approved and prescribed by the President, in respect of the performance within the defined region or locality of the types of operations concerned; and the failure of such an employer to desist from such unfair competition after being given due notice and opportunity to be heard, shall constitute a violation of the requirements of this Code.

The Administrator shall establish one or more Boards for each division or subdivision of the industry concerned to investigate any complaints of unfair competition as defined in this section. Each such Board shall consist of two representatives each of employers and employees of the division or subdivision affected, selected by the Administrator from nominations made by such employers and employees respectively in such manner as the Administrator may approve or prescribe, and an impartial chairman named by the Administrator from nominations made by the employer and employee representatives selected to the Board. Each Board shall give notice and opportunity to be heard to each complainant and respondent and thereafter notify said parties of its findings and report them to the Administrator, as a basis for appropriate action to enforce the requirements of this Code. The provisions of this Section shall not be construed to limit the power of the President, in the absence of such a mutual agreement, to exercise any authority conferred upon him under Section 7 (*c*) of the Act.

Section 2.—Other Hours and Wages

Where no applicable mutual agreement, as provided in Section 1 of this Article, shall have been approved, employers shall comply with the following provisions as to minimum rates of pay, and maximum hours of labor:

A. No employee, excluding accounting, office and clerical employees, shall be paid at less than the rate of forty (40) cents per hour, provided, however, that the provisions of this paragraph A shall not be construed as establishing a minimum rate of pay for other than common or unskilled labor; and provided further that such provisions shall not be construed to authorize reductions in existing rates of pay.

No accounting, office or clerical employees shall be paid at less than the rate of $15.00 per week in any city of over 500,000 population or in the immediate trade area of such city; $14.50 per week in any city of between 250,000 and 500,000 population or in the immediate trade area of such city; $14.00 per week in any city of between 2,500 and 250,000 population or in the immediate trade area of such city; and $12.00 per week in towns of less than 2,500 population.

The foregoing provisions of this paragraph A establish a minimum rate of pay which shall apply, irrespective of whether an employee is actually compensated on a time-rate, piece-work, or other basis.

B. No employee shall be permitted to work in excess of forty (40) hours per week or in excess of eight (8) hours in any twenty-four (24) hour period, with the following exceptions and limitations:

1. On application of the interested parties and after approval of the National Construction Planning and Adjustment Board or Regional Boards established by it, an employee may be permitted to work forty-eight (48) hours in any one week when the following conditions obtain:

(*a*) On projects located at points so remote and inaccessible that camps or floating plants are necessary for the housing or boarding of a majority of the labor employed.

(*b*) On such remote projects, when working time has been lost because of inclement weather or unavoidable delays in any one week, it may be made up in the following four weeks.

(*c*) On projects in localities where a sufficient amount of qualified labor is not available in the immediate vicinity of the work.

2. The foregoing maximum hours of work shall not be construed as a minimum, either for a day or for a week, and if at any time in any locality truly representative groups of employees in a division or subdivision of the industry, through their chosen representatives, express by written request to their employer or employers a desire to share available work in such division or subdivision, the number of hours of work may be reduced by mutual agreement between such employees and their employer or employers. In the event of inability to arrive at an agreement which will not involve undue hardship on either employees or employers, then such difference, with the consent of all parties in interest, may be submitted to the National Construction Planning and Adjustment Board for a decision. The National Board may require the Regional Boards to secure facts and full information relative to such dispute and submit the same to the National Board for its information.

It is not, however, the intent of this provision that any such reduction will be recommended by the National Board to be put into effect if it appears probable that undue hardship might be occasioned thereby to either employers or employees.

3. The following classes of employees are exempt:

(*a*) Employees engaged in professional, executive, or supervisory work.

(*b*) Employees in establishments employing not more than two (2) persons in towns of less than 2,500 population, which towns are not part of a larger trade area.

(*c*) Employees engaged in emergency work, involving breakdowns or protection of life or property.

(*d*) Watchmen.

(*e*) Other employees who may be exempted in chapters of this Code specifically applicable only to the divisions or subdivisions of the industry therein defined.

4. Accounting, clerical or office employees may be permitted to work not in excess of forty (40) hours per week averaged over a period of four consecutive weeks.

C. No employer shall knowingly permit any employee to work for a total number of hours in excess of the hours herein prescribed, whether employed by one or more employers.

Section 3.—Exemptions

Where provisions concerning hours of labor or rates of pay have been established for specific projects, by competent governmental authority or agencies (whether Federal, State or political subdivisions thereof) acting in accordance with law, any employer required to comply and complying with the provisions so established shall be relieved of compliance with any conflicting provisions of this Article or of any actions taken in accordance therewith.

Any employer required to comply and complying with the provisions of a valid labor agreement in force on the effective date shall be relieved to the extent of his legal obligations thereunder of compliance during the period of such agreement, with any conflicting provisions of this Article, or of any actions taken in accordance therewith.

Section 4.—Minimum Age

No employer shall employ any person under the age of sixteen (16) years, or under the age of eighteen (18) years in any occupation hazardous in nature or dangerous to health.

Section 5—Construction Planning and Adjustment Boards

There shall be established within thirty (30) days from the effective date of this Code, a National Construction Planning and Adjustment Board, and said Board shall consist of twenty-one (21) persons, ten of whom shall be selected by the Industrial Advisory Board of the National Recovery Administration from nominations of the Construction Code Authority and ten shall be selected by the Labor Advisory Board of the National Recovery Administration from nominations of the construction employee organizations, the selection in each case to be subject to the approval of the Administrator, and one person to act as disinterested chairman to be selected by the President upon the recommendation of the Administrator.

The National Construction Planning and Adjustment Board shall have for its fundamental purpose the planning and the development of policies that embrace the broad spirit of coöperation and good will in the furtherance of all matters that relate

to the promotion of better relations between employers and employees within the industry and the furtherance of other matters of their mutual interest. It shall have the authority upon its own motion to select technical advisers and seek the coöperation of all factors involved in the stabilization and promotion of the well-being of both employers and employees in the industry, and shall have the authority to make such rules and regulations for its own conduct as it may deem necessary.

It shall, in its own discretion, following the submission by consent of all parties in interest of any difference within or between any divisions or subdivisions of the industry, give consideration and make determinations on all such differences as may arise relating to wages, hours of employment, and working conditions. The decisions of the National Construction Planning and Adjustment Board shall be final and binding on all parties in interest, except that in the event the representative of the Government, the disinterested chairman, shall dissent from the conclusion, the decision shall be held in abeyance until approval or disapproval has been given by the Administrator.

The National Construction Planning and Adjustment Board shall have the authority, and upon its own motion shall establish in properly defined areas, Regional Construction Planning and Adjustment Boards, and said Boards shall be composed of an equal number of members from employer groups and employee groups, and it is further provided that there shall be no disinterested or impartial chairman of said Regional Boards, it being provided that such Boards shall select from their members a chairman and a secretary. The National Construction Planning and Adjustment Board shall upon its own motion submit to the Regional Boards, such problems for study as may in the opinion of the National Board be necessary and such reports of the Regional Boards shall be submitted to the final examination of the National Board.

To these Regional Construction Planning and Adjustment Boards may be submitted matters from their respective areas in disputes having the same relationship as matters to be submitted to the National Board, and every effort on their part shall be made to reconcile such existing differences with the requirement that their action shall in all instances be submitted to the National Board for final action.

Nothing in this Section shall be construed as preventing employers and employees in any division or subdivision of the industry as defined in the chapter incorporated in this Code relating thereto from submitting to the Boards provided for in Article III, Section 1 or other Boards similarly composed and selected for consideration and determination, differences that may arise relating to wages, hours of employment, and working conditions, subject to the approval of the Administrator. The findings of fact and determination of such Boards shall be submitted to the National Board for its information.

The cost of conducting the National and Regional Boards herein provided for, shall be borne by the Construction Code Authority, subject to a budget submitted to and approved by it, provided, however, that the cost of the services and the expenses of the members of said Boards, shall not be paid by such Authority.

Article IV. Administration.

To further effectuate the policies of the Act and to administer this Code within the industry and its divisions and subdivisions, there shall be established a Construction Code Authority, and Divisional Code Authorities, and other administrative agencies as hereinafter provided:

A—Construction Code Authority

Section 1.—Constituency

The Construction Code Authority shall consist of one member selected from and appointed by each of the sponsors of this Code, enumerated in Article II, Section 9 hereof as sponsoring this Code as originally submitted to the President for his approval; except that the Associated General Contractors of America may appoint thereto not more than four (4) members, one of such members to be selected respectively from each of the following component membership groups of said organization: Building Construction, Highway Construction, Railroad Construction, Public Works and other types of construction not heretofore specifically enumerated; together with not more than three non-voting members to be appointed by the Administrator to act as his representatives. To the Construction Code Authority as so constituted and established there may be designated not more than one additional member in respect of each additional chapter hereafter incorporated herein, provided that no such additional member shall be selected by any association enumerated in Article II, Section 9 hereof. The method for the selection of each such additional member shall be described in the corresponding additional chapter. The term of such appointments shall not exceed two years, except that, in the event of code continuance beyond the limit now established by law, terms may be readjusted to insure overlapping tenures of office pursuant to a plan or method approved by the Administrator. Voting members are subject to replacement by the selecting agency with the approval of the Administrator.

Section 2.—Powers and Duties

The Construction Code Authority, acting as a unit or through any designated committee or department created by it from its membership, shall have, in addition to any other powers or duties herein conferred upon it, the following powers and duties:

(*a*) It may establish rules and regulations for the conduct of its affairs; and may appoint such committees, agencies and representatives, and delegate to them such of its powers and duties as it may deem necessary for the proper discharge of its functions hereunder.

(*b*) It shall be empowered to coöperate with the Administrator in making investigations and surveys concerning the functioning of this Code, the observance of its provisions and other pertinent matters whether at the request of the Administrator or otherwise, and report its findings and recommendations to the Administrator.

(*c*) It shall collect from members of the industry and compile and furnish to the Administrator any reports and other information required under the Act. Except as may be required for the effective enforcement of the provisions of this Code the reports of individual members of the industry required under this Code shall be confidential and only compiled summaries of such individual reports shall be furnished.

(*d*) In order to collect the information for the Administrator herein called for, it may require, either directly or through any Divisional Code Authority, the registration, in such manner as it may deem appropriate, of all construction work or services of or in excess of $2,000 in value, and in order to defray the expenses of such registration and of the administration of this Code may apportion such expenses on the basis of the value of the work or services so registered, but in no case shall the charge be less than $2.00. The proceeds derived therefrom shall be apportioned upon an equitable basis between the Construction Code Authority and such Divisional Code Authorities as shall coöperate in procuring the registration of such work or services.

(*e*) It may propose modifications of or amendments to the general provisions of this Code which, after submission to the Divisional Code Authorities affected thereby, may be recommended to the President for his approval, and upon such approval, following such notice and hearing as he may prescribe, shall have full force and effect as provisions hereof.

(*f*) It may exercise the foregoing powers and duties in any division of the industry for which no Divisional Code Authority shall have been established; and, if in its opinion the policies of the Act require, it may recommend to the Administrator that an additional chapter of this Code be established for any such division of the industry.

(*g*) Its members or authorized representatives may attend meetings of any Divisional Code Authority, and it may at any time make appropriate recommendations to the Administrator to insure the proper functioning or representative character of any such Divisional Code Authority.

(*h*) It may secure an equitable and proportionate payment of the expenses of its establishment, maintenance and activities from members of the industry.

B—Divisional Code Authorities

Section 1.—Procedure for Establishing

There shall be established for each division of the industry a Divisional Code Authority which shall, within the limitations provided herein, administer within such division, this Code and the provisions of any chapter hereof applicable specifically to such division. The procedure for establishing each such Divisional Code Authority shall be defined in the chapter pertaining to that division of the industry. The non-voting members appointed by the Administrator to the Construction Code Authority (or their proxies appointed by the Administrator) may serve in like capacity with respect to any Divisional Code Authority.

Section 2.—Powers and Duties

Each such Divisional Code Authority shall, in addition to any other powers and duties conferred upon it in the chapter applicable to its division, have the following powers and duties:

(*a*) It may establish rules and regulations for the conduct of its affairs and may appoint such committees, agencies and representatives and delegate to them such of its powers and duties as it may deem necessary for the proper discharge of its functions hereunder.

(*b*) It shall coöperate with the Administrator and with the

Construction Code Authority in making investigations as to the functioning and observance of any provisions of this Code, at its own instance or on complaint of any person affected, and shall collect from members of the industry and compile and furnish to the Administrator, and to the Construction Code Authority, any reports and other information required under the Act. Except as may be required for the effective enforcement of the provisions of this Code the reports of individual members of the division required shall be confidential and only compiled summaries of such individual reports shall be furnished.

(*e*) It shall study the provisions incorporated in this Code applicable to its own division, and the operation thereof, and after submission to the Construction Code Authority may make such recommendations to the Administrator as it deems desirable for modification or addition thereto. Such recommendations, upon approval of the Administrator after such notice and hearing as he may prescribe, shall become a part of this Code and have full force and effect as provisions hereof.

(*d*) It shall receive and so far as possible adjust all complaints as to trade practices between members of its division in the operation of the provisions of this Code applicable to its division.

(*e*) It may secure an equitable and proportionate payment of the expenses of its establishment, maintenance and activities from members of its division of the industry.

C—Representation and Membership

Section 1.—Modification in Selection

In order that the Construction Code Authority and the Divisional Code Authorities shall at all times be truly representative, respectively, of the industry and of the divisions, and in other respects comply with the provisions of the Act, the Administrator may provide such hearings as he may deem appropriate; and thereafter, if he shall find that the Construction Code Authority or any Divisional Code Authority, is not truly representative or does not in other respects comply with the provisions of the Act, he may require an appropriate modification in the method of selection of the Construction Code Authority, or of any Divisional Code Authority, as the case may be.

Section 2.—General Requirements

The sponsors of this Code who participate in the selection of any Code Authority or administrative agency provided for herein, shall submit to the Administrator true copies of their Articles of Association or Incorporation, Constitution and By-Laws, and other pertinent rules and regulations and any amendments when made thereto, together with such other information as to organization, membership, and activities as the Administrator may deem necessary.

In addition to the information required to be submitted by members of the industry or its divisions under this Code, there shall be furnished to government agencies such statistical information as the Administrator may deem necessary for the purposes recited in Section 3 (*a*) of the Act. Except as may be required for the effective enforcement of the provisions of this Code, the reports of individual members of the industry required under this Code shall be confidential and only compiled summaries of such individual reports shall be published.

Nothing contained in this Code shall constitute the members of the industry or the members of the Construction Code Authority or of a Divisional Code Authority or any committee or agency thereof partners for any purpose. No member of the industry shall be liable in any manner to anyone for any act of any other member of the industry or any agent or employee thereof pursuant to this Code. No member of such a Code Authority, committee or agency, shall be liable in any manner to anyone for any act of any other member, officer, agent or employee of such Code Authority, committee or agency. Nor shall any member of any such Code Authority, committee or agency, exercising reasonable diligence in the conduct of his duties hereunder, be liable to anyone for any action or omission to act under this Code, except for his own wilful misfeasance or nonfeasance.

Article V. Appeals.

Section 1.—Construction Appeals Board

The Construction Code Authority shall establish, under rules and regulations prescribed by and subject to the approval of the Administrator, a suitable agency to be known as the Construction Appeals Board, to consist of one architect, one professional engineer, three general contractors and four special contractors.

Section 2.—Powers of Board

The Construction Appeals Board shall hear and determine the appeals referred to in Section 3 of this Article and shall likewise be empowered to determine, in the event of a conflict between the provisions of the various chapters hereof, applicable to specific divisions or subdivisions of the industry, which of such chapter provisions shall govern.

Section 3.—Complaint Within Division

Any interested party shall have the right of complaint to the appropriate Divisional Code Authority established for any division of the industry, and of a prompt hearing and decision in respect of any decision, rule, regulation, order or finding made by such Authority or its committees or agencies, under such rules or regulations as may be prescribed therefor and the decision of said Authority thereon may be appealed by any interested party to the Construction Appeals Board.

Section 4.—Appeal to Administrator

Any interested party shall have the right of appeal to the Administrator, under such rules and regulations as he may prescribe, in respect of any decision, rule, regulation, order or finding made by the Construction Code Authority or the Construction Appeals Board.

Section 5.—Limitation of Power

No decision, rule, regulation, order or finding shall be made by any Code Authority or other administrative agency, excluding the Boards provided for in Article III hereof, provided for in or pursuant to this Code, whether made pursuant to the foregoing sections of this Article V or otherwise, of or in any dispute between employers and employees, or between groups of employees, including, in such last-named classes of disputes, any case or controversy whose determination would directly involve or affect any dispute between groups of employees as to the right to perform specific types of work or operations, including cases commonly known as trade jurisdictional disputes.

Article VI. Adjustments

In the event that any member of the industry subject to this Code shall have contracted before June 16, 1933, to purchase goods, structures, or parts thereof at a fixed price for delivery after that date and prior to the expiration of this Code, it is equitable and promotive of the policies of the Act that an appropriate adjustment of said price be made to meet any increase in cost to the seller caused by the seller's having signed the President's Reëmployment Agreement or having become bound by any code of fair competition approved by the President; provided, however, that in view of the fact that construction operations customarily involve the furnishing of various goods and structures, or parts thereof by a continuous series of independent long-term contracts and agreements at fixed prices between various parties, such as owners (including government departments), contractors, subcontractors and others, such adjustments may be made contingent upon similar appropriate adjustments to be made by all other parties thus participating, from and including the initial vendor of such goods and structures or parts thereof to and including the owners of the works or structure upon which they are used.

Article VII. Competitive Bidding Practices

Section 1.—Competitive Bidding Defined

(*a*) The term "competitive bidding" as used herein shall mean the submission at or before a definite predetermined time of comparable proposals by two or more invited persons of an awarding authority to execute a specific program of work, furnishing a definite service or supplying a material specifically required for a particular project at a stipulated price. This does not include furnishing quotations on standard products.

(*b*) The term "awarding authority" as used herein shall mean any member of the industry who may upon competitive bidding award contracts.

Section 2.—Bid Peddling and Bid Shopping

(*a*) The practices commonly known as "bid peddling" or "bid shopping" are recognized as unfair and are prohibited. Bid peddling in effect means the offering by the bidder prior to the making of an award of a substitute bid or price lower than the one originally bid without a commensurate decrease in the requirements of the job. The correction of the abuses resulting from such practice is obtainable by regulation restricting or controlling bidders.

(*b*) Bid shopping in effect means the effort on the part of the awarding authority to induce a bidder prior to the making of the award to lower his original bid price without a commensurate decrease in the requirements of the job. The correction of the abuses resulting from such practice is obtainable by regulation restricting or controlling the awarding authority.

Section 3.—Limitation on Bids and Alternates

(*a*) Since it is recognized that the preparation of a bid is a service involving an expense to the bidder and that the inviting

of an unreasonable number of bids is an economic waste, the awarding authority shall not invite an unnecessary number of bids.

(*b*) Only a limited number of alternate proposals shall be required in connection with any bid, and no alternate proposal of a bidder shall be considered by the awarding authority, unless the privilege of alternate proposals is extended to all bidders.

Section 4.—Uniformity of Information

The awarding authority shall make available uniformly to all bidders, plans and/or specifications or other requisite information which shall be sufficiently complete to enable each bidder to prepare a definite bid in accordance with the regulations herein provided for. He shall prescribe terms of competition which shall insure parity of standing to all bidders.

Section 5.—Qualification of Bidders

The awarding authority shall not invite bids from a bidder unless such bidder shall have demonstrated to the satisfaction of the awarding authority that he is competent technically and financially to perform the work, and the ability of a bidder to obtain a performance bond shall not be regarded as the sole test of such bidder's competency.

Section 6.—Award at Original Price

An award if made shall be made at the bidder's original bid price. It is recognized that competition based solely on price is sometimes unfair and accordingly the awarding authority may make an award to a competitive bidder other than the lowest bidder provided the award is made at such competitor's original bid price.

Section 7.—Receipt of Bids

The awarding authority shall designate a specific hour and place for receiving competitive bids. All bids to be submitted by subcontractors shall be delivered to the contractor at least 24 hours prior to the time set for the receipt of the bid of said contractor by the awarding authority. Bids received after such time or from uninvited bidders shall be returned unopened. All bids shall be required to be signed by a duly authorized representative of the bidder and enclosed in a sealed envelope on the outside of which shall appear its identification as a bid for the particular job.

Section 8.—No Influencing of Bidders

The awarding authority shall not at any time prior to the specified time for the receipt of bids convey to any bidder information relating to the price or terms of any other bid in order to influence the price or terms of such bidder.

Section 9.—Collusion Prohibited.

There shall be no collusion between the awarding authority and any bidder, nor between the different bidders in the preparation of any bid. The awarding authority shall not use any bid which is so unduly low as to indicate an error or mistake in estimating without first giving the bidder the opportunity of demonstrating by cost sheets or other methods the correctness of the bid that he has submitted.

Section 10.—Time Limit on Awards

The awarding authority shall make an award or reject all bids for the principal contract with the owner within twenty (20) days after the stipulated time for the receiving of bids except where an extension of time has been requested from the bidders and has been consented to by two or more bidders. In the case of bids conditioned upon the award of a previous contract, each succeeding awarding authority shall make an award or reject all bids within thirty (30) days after the award of such previous contract except as to such bidders as shall agree to an extension of time. The right to reject any or all bids may be reserved by the awarding authority, and such rejection shall be made in writing. Where all bids are rejected, bids shall not be again invited or submitted for the mere purpose of obtaining a lower or revised price or prices for substantially the same work previous to the elapse of ninety (90) days from the date of such rejection, except there be a substantial change in the plans and/or specifications, or except there be evidence of collusion, or except there be such a marked difference between the bids submitted and the awarding authority's estimate as to the valuation of the work as would indicate to the awarding authority and his Code Authority the necessity of new bids in order to secure fair competition.

Section 11.—Naming of Subcontractors

Before making an award the awarding authority may require any bidder to name the subcontractors whom such bidder intends to employ for the various divisions of the work bid upon.

Section 12.—Rebates, Refunds and Discounts

The awarding authority shall not accept rebates, refunds, discounts, or other special allowances or services from a bidder unless included by the bidder in his original bid.

Section 13.—Owners' Compliance

The various divisions and subdivisions of the industry may provide in the chapters specifically applicable to such divisions or subdivisions, that members of the division or subdivision shall not submit a competitive bid, as defined in Section 1 (*a*) of this Article, to an owner or any other person, corresponding to an awarding authority as herein defined unless such owner or other person agrees to comply with the regulations provided herein governing an awarding authority.

Section 14.—Checking Bids

In order to enforce the practice of fair competitive bidding, the Divisional Code Authorities shall provide, if no such method is provided in the chapter applicable to such division, a method satisfactory to the Construction Code Authority for checking bids submitted by members of such division either by designating a depository for the filing of duplicate bids or by some other acceptable method. The Construction Code Authority may require such changes in any such method as may be necessary to prevent conflict between the various methods which may be adopted by the various Divisional Code Authorities.

Article VIII. General

Section 1.—Labor Provisions of Act

Employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection; no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing or assisting a labor organization of his own choosing; employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

Section 2.—Reclassification of Employees

Employers shall not reclassify employees or duties of occupations performed by employees with the intent or for the purpose of defeating the purposes of the Act.

Section 3.—Federal or State Laws

No provision of this Code shall supersede any State or Federal law imposing more stringent requirements on employers regulating the age of employees, wages, hours of work, or health, fire or general working conditions than those contained in this Code.

Section 4.—Monopolies

No provision of this Code shall be so construed or applied as to permit or promote a monopoly or a monopolistic practice, or to eliminate or oppress or discriminate against small enterprises.

Section 5.—Additional Chapters

Additional chapters to this Code may be submitted to the Construction Code Authority for submission by it for the approval of the President but nothing contained herein shall be construed to prevent any representative association or group from submitting any such chapter directly to the President for his approval, provided that the Construction Code Authority, if then established, shall be given an ample opportunity to consider and examine any such chapter prior to its submission to the President to the end that there may be proper coördination within the industry and between its various divisions and subdivisions. Upon approval by the President, such chapter shall become an integral part of this Code the same as if originally included herein, but any exceptions therein to the general provisions of this Code shall apply only to the members of the division, or subdivision of the industry to which such chapter pertains. No specific provision of this Code applicable to its amendment or modification shall constitute a limitation upon any right to propose such amendments or modifications which may be conferred by the Act.

Section 6.—Presidential Powers

This Code, and all the provisions thereof, and of any chapter thereof, are expressly made subject to the right of the President, in accordance with the provisions of subsection (*b*) of Section 10 of the Act, from time to time to cancel or modify any order, approval, license, rule or regulation issued under Title I of the Act and specifically, but without limitation, to the right of the President to cancel or modify his approval of this Code, or of any additional Chapter thereof, or any conditions imposed by him upon such approval.

Building a Forest Road in Nevada

Disintegrated granite was used to surface this forest road built under the supervision of the U. S. Bureau of Public Roads in Nevada. The illustrations show: Upper left—Drilling a cliff preparatory to blasting; upper right—Spreading surface with a tractor and grader; middle left—Breaking up large lumps of surfacing material with sledges; middle center—Building a 6 by 3 ft. concrete box culvert; middle right—Spreading material with a spreader; bottom—Drilling a cliff that is to be blasted down to improve a wave in the road. This public works forest highway cost $11,500.

Chiseling the Road Dollar *of the Motorist*

By ROY F. BRITTON
Director, National Highway Users Conference

THE special taxes paid by the motor vehicle owners of the country constitute the principal source of revenue for highway construction and maintenance. The motorists' state registration fees and gasoline taxes pay most of the cost of the state highway systems and a good part of the cost of local roads.

Why then should these special fees and taxes be used for any other purpose? There is no sound reason!

But in recent years, governors and legislatures, faced with shrinking revenues and unbalanced budgets have frantically seized, or attempted to seize, these special levies for general administrative uses, for unemployment relief, and for other purposes, not related to highways. The major part of highway expenditures goes to labor and these officials overlook the very important fact that when highway revenues are misappropriated, money is taken from self-supporting workers and given to others as a dole.

If taxes specifically imposed for highway construction and maintenance purposes are diverted to general governmental use, or if the motorists' special taxes are increased for such uses, the effect is to place upon the motorists as a class, a burden which should be borne by the people of the state as a whole.

The motorists pay their share of the general cost of government in their capacity as citizens. If and when emergencies arise that require revenue over and above those available from general taxes, then whatever additional revenue is necessary to meet the emergencies should be raised from taxes that would be general in character and fall equally on all classes of the population.

Class legislation or class taxation has always been abhorrent to the American people. A fair distribution of the cost of government cannot be obtained by assessing special levies on selected classes, especially when the levy is made without regard to the taxpayers' ability to pay.

History of Highway Financing.—The imposition of special user taxes for road construction and upkeep is essentially a modern idea. It has no place in our old systems of taxation. The development of this method of highway financing is traced in the "American Transportation Problem" by Dr. Harold G. Moulton and Associates, prepared for the National Transportation Committee of which the late Calvin Coolidge, former President of the United States, was Chairman. Let me quote a few significant paragraphs from Dr. Moulton's report:

"Highway development in the United States has passed through three distinct phases, each characterized by the administrative dominance of a different agency, or combination of agencies. In the early period, extending to the middle of the nineteenth century, the Federal Government assumed the initiative in furnishing major highway routes, but gradually relinquished the responsibility to States through which the routes passed. In the meantime, various States had found the development of subsidiary highway routes excessively burdensome and had placed highway development on a commercial basis by granting charters to individuals and companies, empowering them to build and operate roads and to charge tolls for their use. The States, however, participated in the financing of these projects and retained the right to regulate their use. This first phase of highway development, then, was one of centralized control and semi-commercial operation.

"The second phase in the evolution of highway transport embraces the era of rapid railroad building. During this period 'The calamity of the railway' fell on toll-road operations; States transferred their official favors to railroad development and highway transportation declined to a position of minor importance. As soon as transport over public roads became unnecessary and unprofitable except for short distances, the building and maintenance of roads was reduced to a matter of local concern and consequently was left to minor political subdivisions—the county, township and road district.

"Thus between the middle and the end of the nineteenth century only a relatively small portion of highway travel passed beyond county boundaries. Under such conditions the administrative and financial responsibility for furnishing highway facilities quite naturally narrowed down to the political units whose areas most nearly conformed to the economic limits of highway transportation.

"At the turn of the century the transportation of goods and persons over public roads entered its third and present phase of development, characterized by a rapid increase in highway usage. As a result of the coming of the automobile it soon became apparent that the increased operating radius of highway travel was creating traffic which bore no relation in point of origin and destination to purely political boundaries, and that such traffic was a basically different character from the type which moved wholly within a local area. It was further realized, vaguely at first, that the cost of highway facilities required by these different types of traffic could not with equity be assessed wholly against local property owners, but that a certain portion of the costs should be assessed against general state funds collected from taxpayers at large. From this recognition of the existence of dissimilar types of traffic there emerged the conception of general use highways and land utilization highways."

Development of Motor Vehicle Taxation.—The general practice of assessing special taxes against motor car users developed with the growth of the motor vehicle. From a handful of vehicles at the beginning of the century, and these confined almost exclusively to passenger cars, motor production and use increased by leaps and bounds, so much so that in 1929 there were registered in the United States 26,000,000 motor vehicles of all types. To begin with, their use was confined to restricted areas, because of the limited mileage of improved roads. Originally the laws requiring motor vehicle license taxes or registration fees were purely police measures; identification was their chief purposes. They were not revenue measures. Two decades ago the courts frowned on efforts to use inspection laws and police regulations as revenue measures. But the growth of the automobile brought about a new theory of taxation which the courts have approved—and properly—in keeping with the march of progress.

As has been stated, roads were formerly built by special benefit assessments and by general taxation. This was conceded to be a proper method of financing because the roads furnished a means of access to property and served the community at large. But as automobiles multiplied and the income from license fees increased to great sums, the motor vehicle owners themselves supported the principle that the funds thereby created should be expended on the construction of highways. This was the case in nearly all of the States. This was a departure from the accepted theories of taxation and I believe it is the only instance on record of taxing a class for purposes

which benefit the community at large, as well as the class which pays for the improvement.

Then the gasoline tax was added and road building expanded enormously. There was created a sort of "benign circle." As the proceeds from these sources of taxation grew, more roads were built, which increased the use of the automobile, which in turn produced more revenue for roadbuilding, and so on.

Thus, it will be seen that there has been developed a special system of taxation for the purpose of constructing and maintaining highways. If the rates of special taxation yield more than is necessary for that purpose, they should be reduced. There is no justification for using the proceeds for any other purpose. Such a diversion is a plain and palpable misappropriation of funds.

Public Opinion Opposed to Diversion.—The essential soundness of this contention is proven by the fact that it is not the special pleading of any particular group. On the contrary, the principle that special motor taxes should be imposed and used for roads and roads alone has been endorsed over a period of years by a wide variety of groups, organizations and industries—so divergent in character and objectives that they may well be regarded as reflecting an all but universal public opinion in this country. It was given official sanction in 1932 by the Federal Oil Conservation Board; it was the subject of agreement by the Joint Committee of Railroads and Highway Users. It has been repeatedly affirmed by the American Automobile Association, the great federation of private passenger car owners. The agricultural organizations, the National Grange, the American Farm Bureau Federation, and the Farmers' Union have insisted that highway revenues must not be misappropriated to other purposes. American business, speaking through the Chamber of Commerce of the United States, has taken the same position. The National Rural Letter Carriers Association, speaking on behalf of its 40,000 highway using members, serving 25,000,000 rural residents, has protested against the diversion of highway funds and so has the National Industrial Traffic League, the leading national organization of shippers.

Among others that have voiced their protests are the American Petroleum Institute, the American Association of State Highway Officials, the National Automobile Chamber of Commerce, the Portland Cement Association, the Asphalt Institute, the American Road Builders' Association and the Associated General Contractors of America.

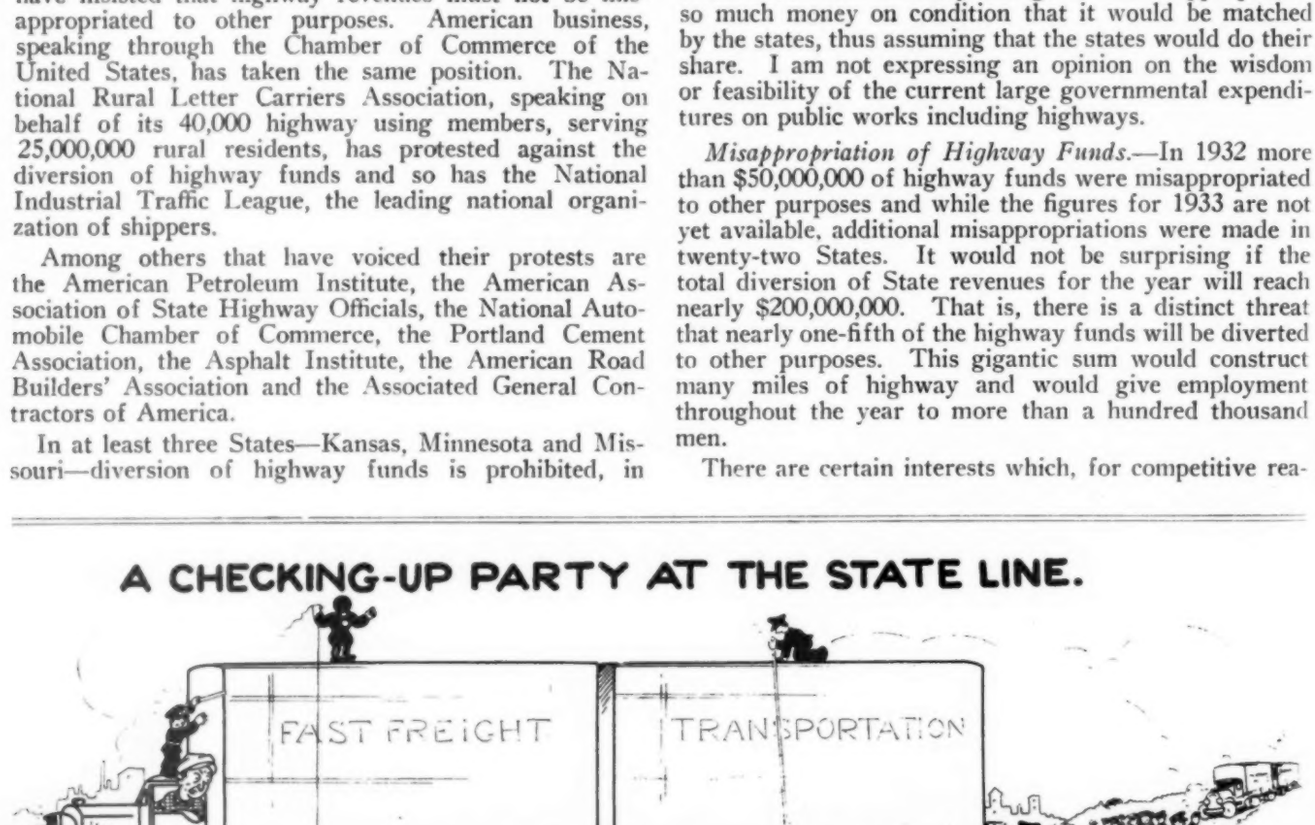
In at least three States—Kansas, Minnesota and Missouri—diversion of highway funds is prohibited, in whole or in part, by constitutional provisions. In fact, whenever the people have had an opportunity to vote directly on this proposition, as they have done in California and Missouri, they have decreed that special user taxes shall not be diverted to purposes other than highway construction and maintenance. Eventually legislators must be responsive to this decisive trend of public sentiment.

Federal Motor Vehicle and Gas Taxes Should Be Abolished.—The federal excise taxes on motor vehicles, parts and accessories, tires and tubes, gasoline and lubricant constitute unjustifiable levies on motorists as a class. It is sometimes contended that such taxes are warranted because of Federal aid in highway construction, but there is an important obligation on the part of the United States Government to assist with road building in connection with the National Defense and facilities for the delivery of the mail. These are benefits which accrue to the nation as a whole and not to a particular class. And yet the Federal Government has collected more from the motorists than it has expended on Federal Aid. Those who advance the theory that Federal Aid is a justification of special federal automotive taxes wholly overlook the history of the Federal Aid movement as a national policy. One need only look through the debates in Congress at the time when this policy was launched to be convinced that the framers and advocates of the basic legislation had no thought of compelling one class of population to support the policy through special levies. All the federal automotive excise taxes should be eliminated.

In speaking of Federal Aid, I am speaking of the old established basis whereby the government appropriated so much money on condition that it would be matched by the states, thus assuming that the states would do their share. I am not expressing an opinion on the wisdom or feasibility of the current large governmental expenditures on public works including highways.

Misappropriation of Highway Funds.—In 1932 more than $50,000,000 of highway funds were misappropriated to other purposes and while the figures for 1933 are not yet available, additional misappropriations were made in twenty-two States. It would not be surprising if the total diversion of State revenues for the year will reach nearly $200,000,000. That is, there is a distinct threat that nearly one-fifth of the highway funds will be diverted to other purposes. This gigantic sum would construct many miles of highway and would give employment throughout the year to more than a hundred thousand men.

There are certain interests which, for competitive rea-



sons, are opposed to the natural development of highway transportation. These interests are opposed to highway building. They have charged that there has been a vast amount of extravagance and waste in the construction of surfaced roads; that there has been much overbuilding of high type roads; that many miles of roads have been constructed at additional cost simply for the accommodation of heavy vehicles.

As to the charge of extravagance, there is no scintilla of evidence to sustain it. As to the charge that additional expenditures have been made on account of commercial vehicles, all the evidence points to the fact that general traffic needs, including the needs of the Federal Government and the special needs of communities, determined the specifications that have guided the Bureau of Public Roads and our state engineers, rather than requirements of commercial vehicles as such. As to the charge that there has been overbuilding of highways, the best answer will perhaps be furnished by a quick survey of the status of road improvement in the country today.

Main Road Systems 74 Percent Completed.—Our state highway systems constitute the main arteries of travel. They are the trunk lines connecting the principal population centers of the country. There are about 360,000 miles of road in these systems and at the end of 1932, 266,000 miles had been surfaced. That is, after sixteen years of planning, financing and intensive work, with the assistance of the Federal Government, the job of surfacing the main highways of the nation was only 74 percent completed. Of the surfaced roads approximately 110,000 miles, or 41 percent were of the high type construction. As of that date, low type surfacing such as gravel, waterbound macadam, sand and clay amounted to 156,000 miles, while about 92,000 miles in the system were without surfacing of any kind.

We have 3,000,000 miles of public roads in the nation. At the end of 1912 about 900,000 miles were surfaced, of which about 150,000 miles were high type construction. Only one mile out of every six surfaced miles was of high type surfacing and only about one mile out of every twenty of our total road mileage was of high type. So, it is clear that the contention that there has been an unnecessarily large percentage of high type construction is wholly untenable.

Public Need Not Met.—Opponents of highway development endeavor to create the impression that the public's road requirements have been more than adequately provided for and that there should now be a "highway building holiday." With more than two-thirds of our road mileage entirely unsurfaced, the absurdity of this contention is self-evident. Highway building has not kept pace with motor vehicle development. That is apparent to the most casual observer of the congestion on our highways. While millions have been expended on construction; while many miles of serviceable roads have been added each year, particularly since Federal Aid was inaugurated, we are still a long way from the goal of adequate road facilities.

In 1914 there were seven motor vehicles to each mile of surfaced road in the country. Now we have about twenty-five motor vehicles to each surfaced mile. Thus, in spite of the tremendous highway development, we have more than three times as many automobiles using each mile of improved highway as we had twenty years ago.

Economic Justification for Highways.—I am not in sympathy with the contention that road building requirements should be reduced entirely to a scientific formula regardless of all other considerations. Of course, economic justification and good engineering should always prevail. But there are those, particularly among the enemies of highway transportation, who advocate the policy of building roads just wide enough and just thick enough to accommodate the ordinary flow of prevailing light traffic. No other capital investment is measured with such a parsimonious or short-sighted yardstick.

Our buildings, our commercial and industrial plants, our streets and our sidewalks are not constructed according to specifications which will produce only the indispensable structure. They are constructed with due regard to endurance and appearance as well as to withstand the ravages of the elements.

Safety and speed are given special attention in the building of railroads, which are noted for their more than sturdy construction. And so with our highways, endurance, safety, speed and future traffic needs must figure largely in the specifications. Highways are public works. They are being built in response to the demand of the people—the sovereign power of this country. Public works in varying degrees are expressions of our national ideals and our national pride as well as of our needs.

The social advantages and community benefits flowing from public works, including highways, cannot be computed with scientific exactness, nor can the relationship of these advantages and benefits be nicely balanced with the cost of improvements or reduced to a precise economic formula.

Highway Building to Continue.—Regardless of protests and objections of special interests, we will continue to build highways in this country because the people want them built and we will continue to build the kind of highways the people need for the use of modern vehicles of motor transport.

A necessary first step in the construction of a comprehensive connected system of improved roads was the development of the main thoroughfares—the trunk lines. Splendid progress has been made with this work. A large percentage of the main highways have been adequately surfaced for present needs, but these important thoroughfares have not all been constructed to a proper standard and many of them will require improvement or extension as the density of traffic increases. But at the same time, two-thirds of the country's total mileage is as yet unimproved with any kind of surfacing.

One phase of improved road construction is just entering in a large way its field of greatest usefulness —the so-called "feeder" or farm to market roads. The real value of the main highways will be completely realized only when these feeder roads are also improved. Naturally the two types serve each other.

There is also a great need for "traffic relief" roads, particularly in the congested areas around the large cities. The so-called "bottle necks" of traffic must be replaced with multitude lane highways, adequate to carry safely the enormous flow of passenger car movements which now crowd the two lane roads.

There is an active demand for the building of arterial streets in cities. These must be wide enough to accommodate the traffic converging on the cities from the State highway systems. They are really extensions of the State highway systems through municipalities and they require expensive construction, often including the purchase of rights of way which should not be borne entirely by the adjacent property owners.

Highways Need Motorists' Taxes.—No one who stops to contemplate our road needs for the present and for the future, from the standpoint of pleasure, safety and commerce, can question for a moment that there is urgent

need for every cent of road money accruing from the motorist's dollar. He may in some instances be paying too many dollars—but that makes it all the more imperative that every dollar he pays should be used for the purpose for which he pays it.

How can the misappropriation of highway funds be stopped? Of course, we should all continue to protest as vigorously as possible but it seems plain that something more tangible and definite should be planned.

The motorists cannot be expected to pay the whole cost of improving all of the roads. The tax per car would be prohibitive. However, it is generally conceded that special user taxes should pay the cost of building and maintaining the State highway system and also a portion of the cost of the local roads and arterial routes through cities, that portion to be determined by the extent to which such local roads and arterial routes are in general rather than in local use.

Rational Highway Programs Must Be Developed.—In each State thorough studies of highway requirements should be undertaken. These studies should include an inquiry into the social and educational, as well as the economic needs for particular improvements. Reliable information on highway construction costs should be gathered. Traffic counts should be made. Administrative and financing practices should be studied. With the proper data available intelligent policies can be developed.

The authorities, with the cooperation of interested groups, can then lay out economically sound programs of highway extension and improvement. They should be rational but long-range programs which will contemplate the ultimate development of a complete and continuous system with feeder and supplementary roads serving every part of the State.

Motor Taxes Must Be Reasonable.—Reasonable rates of special user taxes to pay the cost of the whole program over a period of years can then be determined and these taxes must be exclusively committed to such a purpose.

It is, of course, necessary to adjust the program to the users' ability to pay. High rates produce evasions and eventually the law of diminishing returns sets in, reduces the use and this is followed by a decrease in the revenue.

The automoble is a necessity to modern life. It is not a luxury. It is the average man's convenient and flexible form of transportation. About nine automobiles out of ten are those which sell for less than $750 wholesale, and many of the cars in use today have cost the present owners considerably less than that figure.

The average automobile owner is not a wealthy person. A great majority of motor vehicle owners are salaried people, wage earners and farmers.

Around five million motor vehicles are on the farms. Twenty-six percent of the trucks are owned by farmers.

Therefore, both registration fees and gas taxes must be reasonable.

To the average motorist "diversion" or "misappropriation" of highway funds are vague terms. He does not fully realize what the practice means to his pocket book. If he were acutely conscious of the real effect; if he definitely understood that he was being selected for special taxation, or that his dollar, contributed for a specific purpose, was being used in whole or in part for other purposes he would protest vigorously and vociferously.

But the average motorist does not now understand the full significance to him as an individual of diverting highway funds.

He can and will understand a comprehensive plan of State-wide road development: he can visualize it. He will know how long it will take to execute the plan; what it will cost as a whole; and what it will cost him individually from year to year.

Most important of all he will know that, if his special taxes (imposed to pay the cost of the work) are diverted to other purposes, the plan cannot be carried out.

Public interest in the program as a whole and sectional interest in specific projects will serve to prevent the misappropriation of funds until the job is finished, or better still—constitutional amendments will absolutely prevent such diversion.

In conclusion permit me to say a few words about the National Highway Users Conference.

The National Highway Users Conference.—It is not an association. It is just what its name signifies—a conference of existing associations whose members are interested in highway transportation, highway construction and taxation. It is composed of all classes of highway users, it does not act on behalf of any specific group. It is an information and coordinating agency.

The comprehensive character of the Conference is indicated by its officers and governing board. The Chairman is Mr. Alfred P. Sloan, Jr., President of General Motors; the Vice-Chairman is Mr. Ernest N. Smith, of the American Automobile Association; the Secretary is Mr. L. J. Taber, Master of the National Grange.

The Board consists of representatives of other agricultural, shipping and industrial organizations.

These groups, of course, cannot be expected to agree on all things relating to highway construction, use or taxation, but they are united on the proposition that motor vehicle owners' special taxes shall be used for highways and for no other purpose.

Acknowledgment.—The foregoing is an address presented Jan. 30 before the annual convention of the Associated General Contractors of America, Inc.

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And Now South African Rys. Fear Competition of Animal Transport

After having successfully stifled motor transport competition on the Union of South Africa highways, through the introduction of the restrictive Motor Carriers Transportation Act and its amendment, the Administrative officials of the State owned and operated South African Railways are carefully observing the effect of the existing competition encountered in the form of animal-drawn vehicles, according to Automotive World News of Feb. 20.

That the Railway Administration is greatly concerned over the loss of ***high*** traffic to animal transport is indicated in the Report of the General Manager of Railways and Harbors for 1935, which has just been published, from which is quoted the following:

"With regard to animal transport competition, owing to financial stringency and other hardships, a large number of the porer type of farmer has resorted to transport aiding as a means of livelihood. By reason of the exremely low rates, many of these operators are paid in kind and not in ***cash*** for their services, the volume of traffic, mostly ***high-rated,*** filched from the railways has assumed considerable proportions."

"This disadvantage, caused by unfair and uneconomic animal transport competition with the railways, to traders and others who are loyally adhering to their agreements with the Administration, are fully realized and appreciated." The matter is however, one which bristles with difficulties and, notwithstanding close study of the problem, a solution has not yet presented itself."

The Lower-Than-Cost Bid From the Highway Engineer's Standpoint

By S. G. COHEN
Engineer of Construction, Indiana State Highway Commission, Indianapolis, Ind.

IF Mr. R. E. O'Connor* has accomplished nothing else, I am sure that he has made a successful case against the "Lower-than-Cost" Bid. The construction industry, itself, has known over a period of years that the public was really not buying any bargain when public work was contracted at a price that constituted a loss to the contractor. However, both the law and public sentiment have in the past required that the work be awarded to the "lowest and best bid." Regardless of how low the bid or how plainly the loss was apparent, if the low bidder was qualified by experience and financial ability to perform the work, the awarding official has had no alternative other than to award.

The Aftermath of Low Bids.—Such awards have usually left unpaid bills, dissatisfied and poorly paid laborers, delayed completion, and dissatisfaction in general in their wake. Bond protection has seldom meant prompt settlement. In fact, experience has shown that the best and most reliable assurance that the public has for prompt and most satisfactory construction is obtained through award to a reputable and competent contractor at a price that includes a legitimate profit, under average conditions.

The State of Indiana offers many examples of both pictures. We have plenty of very excellent projects that were completed well ahead of schedule to the mutual satisfactoin of engineers, inspectors, contractors, and communities. Such jobs are the work of the reputable contractor and are seldom given their inception by a "Lower-than-Cost" bid.

When Low Bids Did Not Prove a Public Bargain.—On the other hand, I am told that not a single firm is now known in business that participated in the construction of State Road 52 between Indianapolis and Lafayette. The history of the road includes a record of low bids, long delays, not all the contractor's fault, financial debacles, unpaid bills, and damage suits. That highway was built for its utility and was not intended as an endurance test for either the public or the construction industry. I am quite sure that those low bids did not prove to be public bargains.

The National Recovery Act, however, has prepared a legal background and moulded a public sentiment that makes possible the outlawing of the "Lower-than-Cost" bid. I can well appreciate the sentiment of the representatives of the general contractors when they offered to subdue all other contentions if their code could include a clause to "prescribe bidding rules, requiring the inclusion in each bid of all direct and indirect costs, properly defined, etc." Such a bidding arrangement is, I believe, the cure of an ailment as old as the construction industry.

Development of Method Difficult Matter.—However, the development of a method for the awarding of public construction contracts, that will reflect all the principles of the National Recovery Act and deal justly with both public and industry, is truly a difficult matter. The A.G.C. group, which with Mr. O'Connor has been so tirelessly working, has given a lot of time and thought to this problem. I am sure they have not considered lightly the leading part the federal government has assigned them in the solution of this national crisis. Surely it is not necessary that I explain the fact that the construction industry is truly a medium for the distribution of the vast federal fund for relief and recovery. If we are to live up to the responsibilities assigned us, we will not develop a method for the allocation of public contracts that can in any way shake the public confidence.

The Average Bid Method of Selection.—It is my personal conviction that the average of the bids below the average bid is not a just approach to a minimum price, for which a given project is to be awarded. For the contractor, the incentive to be low is gone and without that incentive, the letting appears to me to become a drawing. When the contractor presents a carefully prepared bid to such a procedure, its consideration is certainly inconsistent. I will grant that it is a fair method for the selection of a bid other than the low one but I do not see where it can serve as a corrective measure in line with the principles involved. Further, in its application I can see where conditions will arise that will become very questionable, to the public interest. I don't believe that the comparative values of the responsibilities and equities of the bidders can be measured by the average and area method.

Maximum and Minimum Estimate Plan.—Mr. O'Connor has stated that if it is reasonable to have the awarding body fix a maximum estimate, above which no award will be made, it is just as reasonable that by the same reasoning they should have a minimum estimate below which they would make no award. I can find no flaw in his logic. The engineer's estimate of the past was evidently designed by law to protect the public against awards that involved excessive profits. In the old order of things, it was not considered necessary to prevent industry from working at a loss, if it so elected, and bonded itself to so do. If our local laws can be modified to recognize that principle of N.R.A. and a legal status be established for minimum bids, I can see nothing impossible or impractical about it.

I believe that the minimum estimate should be an estimate of cost only, so that any bid in excess of it should be deemed profitable. I will acknowledge that such a system would put the estimator "on the spot" but there is nothing unusual about that position for the public official. I believe that the maximum estimate has truly served as a just protection for the public's interest and I can now see no reason why the minimum estimate would not serve as just as equitable protection of both the interests of public and industry.

In this discussion, thus far, I have deigned to both agree and disagree with the speaker, but have confined myself entirely to the discussion of ideas original with him. However, I would like to submit to the group one idea of my own origin, to give Mr. O'Connor and others the opportunity for some healthy cross-fire.

Referring again to the one clause that the contracting group have described as the one most desirable, and granting that it does become a part of the approved

*Director, Indiana Highway Constructors, Inc.

code, I quote, "It may prescribe bidding rules requiring the inclusion in each bid of all direct and indirect costs, *properly defined,* and method for administering such rules and the same, when approved by the administrator, shall apply to the respective sub-division proposing the rules."

When such a clause does become code and "all direct and indirect costs" *are* "properly defined," a uniform cost accounting system truly becomes possible. The word "cost" can finally emerge from its hiding place and mean the same to all individuals.

A New Form Proposed.—I propose that a new form be developed that will include all of the elements of "direct and indirect cost" based on their code definition, for each important unit in the contract, and this form be made a part of every contract proposal. By this means, every bidder will be presented with the same elements of cost for consideration in the preparation of the bid. He will no longer be able to forget and his conception of direct and indirect cost will be before the awarding official when his bid is being considered.

The awarding official, armed with the principles of N.R.A. and code, can compare such calculations with those of the public estimator, can confer with the bidder where conference is necessary, and after due deliberation of such data, can intelligently award or reject.

It might well be contended that the elements of any individual bid are the trade secrets of the bidder, based on his own investment in past cost accounting and the development of judgment, due to his own experiences. True as that may be, such possessions are only a handicap when operated in a competitive market, not uniformly so equipped. Further, the costs of one exposed to another does not infer the right to use them. They are the measure of organization efficiency and the fact that your organization developed certain costs under certain circumstances, are no guarantee that mine will perform likewise. Consequently, I don't believe we have much of value to thus conceal and I believe that the general benefit to be gained will far exceed in value what the individual might lose.

Code Enforcement.—Before I close, I want to add a few words on the subject of code enforcement. I do not believe that it is the function of the public official to act as the code policeman for every industry with which he comes in contact, nor do I believe that he has a right to interfere with the proper operation of any code. By this I mean that it is not the function of the public official to clothe himself with the authority of judge and jury and pass judgment on what shall constitute a code violation. It is my understanding that code authorities have been created for that purpose. I still retain enough "rugged individualism" to believe that any industry operating under code that permits itself to suffer from a known ailment can not mandate my services as a guardian. However, I do contend that it becomes the duty of the public official to recognize the positive action of code authority. Also, I further contend that coöperation should be extended in the form of reasonable delay whenever written notice is given that action of code authority has been requested in a specific instance.

In conclusion, let me state that I can think of no matter pertaining to the construction industry that is of more importance than the considerations that we are discussing. They are worthy of the best minds and the best efforts that the personnel of the industry affords.

Acknowledgement.—The foregoing is a discussion of a paper presented by R. E. O'Connor, Contractor, at the 20th Annual Purdue Road School.

Rebuilding a Timber Bridge

The following account of the reconstruction of the bridge over the Nicholson River at Sarsfield, Victoria, Australia, is taken from the 20th annual report (for year ended June 30, 1933), of the Country Roads Board of Victoria, the description being given by L. F. Loder, Chief Engineer of the Board.

The bridge was originally constructed about 40 years ago, and consisted of four stringer spans and a 60-ft. truss span, with a width between curbs of 15 ft. Investigation showed that the old log abutments were badly infested with white ants, that some piles were in bad condition, and that the truss timbers were dangerously decayed. The width between curbs was inadequate, but 50 per cent of the stringers were sound and two river

Reconstructed Bridge over Nicholson River at Sarsfield

piers were in good order and the deck planks generally good. It was determined to reconstruct the bridge to a width of 20 ft. The center truss was replaced by two 30-ft. stringer spans with a new central pier. The reconstructed bridge is shown in the illustration.

Several features of construction for this type of work are of special interest.

Without altering existing piers and stringers (except for replacement of old members), a width of 20 ft. in place of the previous 15 ft. width was obtained by the use of crossbeams and longitudinal decking.

The pile lengths required for the center pier, if of one piece, were over 60 ft. The portions below water level were, however, only 25 ft. These were, therefore, driven from a pair of leaders supported by the deck of the old bridge, and spliced at low-water level by a concrete sleeve, as shown in the picture.

The old piles were in good order from a few feet below ground level. They were cut off at this level, a new top pile set in position, and the two spliced in the standard manner. The pier so treated is shown on the far bank.

The concrete slabs were precast to the correct lengths to span between piles and of section of 12 in. x 3 in. The appearance of the abutments is shown in the illustration. It is to be noted that, although 11 ft. of earth filling is retained, no trace of cracking in any slab has been found.

There was no difficulty in the superstructure conversion of the stringer spans. For the truss span, the new center pier was first completed without disturbing traffic. Traffic was then converted to half width on the old truss, while the 30-ft. stringers were placed without disturbing the truss system other than cutting away portions of the transverse floor beams. After this new portion of the bridge was sufficiently completed to transfer traffic, the trusses were removed and the work completed.

An Improved Method of Measuring the Speed of Traffic

A FURTHER development of field methods for determination of vehicle time loss in connection with traffic studies is reported by E. H. Holmes and Lawrence S. Tuttle, Assistant Highway Economist, U. S. Bureau of Public Roads, in the February issue of Public Roads.

The method used in the New Jersey Viaduct study* consisted of recording the licenses and the times of passage of vehicles at both ends of the route under consideration. Since the length of the route was about 4 miles, recording of time to the nearest minute was sufficiently precise. A large proportion of the vehicles were recorded in this way and the average travel time was determined from the travel time of the individual vehicles.

In the method used in the Constitution Avenue and Seventeenth Street (Washington) study* the travel time per vehicle was not determined by averaging the time for individual vehicles. Instead the average time was obtained by dividing the aggregate time for all vehicles by the number of vehicles. Here the distance was but a few hundred feet rather than several miles, and so the time of passage of the vehicles had to be noted precisely. The required precision was obtained with the electric time recorder, which permitted timing to the nearest second. While this type of study was very precise, its accuracy was dependent on the "incoming" and "outgoing" records being in exact agreement.

Limitations of the Previous Methods.—The two methods, while entirely satisfactory in each special case, are limited in their application. The first method can be used only where the distance over which the vehicles are to be timed is great enough that recording to the nearest minute, or possibly to the nearest half minute, will give the elapsed time with sufficient precision. This method is advisable only when most of the traffic passes both observation points, for otherwise the sample is small. Such diversions or entrances of traffic may be accounted for, however, by the use of additional observers at the diversion points. The second method is useful only over a short distance where both ends of the section of street or highway are readily visible from a selected point, which sets a practical limit of about 1,000 ft. to the length of the section. Difficulty is encountered if there is a considerable amount of stopping or parking within the section studied, or if vehicles enter or leave at points other than those at which the observers are located. Stores, filling stations, or building entrances make such a study very difficult, while another street intersection within the "zone of influence" of the intersection being studied excludes this type of study entirely.

Observations at intersections in business sections recently investigated were so complicated by business stops and by the long lines of vehicles awaiting signal changes during the rush-hour traffic that neither method was suitable. However, a combination of the two methods proved successful.

Combination of Two Methods Successful.—Under this system, the licenses are recorded as the vehicles enter and leave the "zone of influence" of the intersection, and the time of passage of each vehicle is noted on the time-recorder chart by the closing of a circuit with a telegraph key as in the regular intersection study. This type of recording requires two observers at each post for each direction. One reads aloud the license number and simultaneously records the time of passage of the vehicle with the telegraph key. The other writes on a ruled sheet the number read by the first observer.

In order to correlate the time record appearing on the strip-chart with the license record shown on sheets, it is necessary for the observers to designate at frequent intervals a certain car as a "check" vehicle. The license number of this vehicle is checked or otherwise noted on the sheet, and its time of passage indicated on the time-recorder chart by a special manipulation of the telegraph key. Usually it was found convenient to check every tenth vehicle in this way, with distinctive notations for the fiftieth and hundredth vehicles. To facilitate this correlation of the record, the sheets used by the observers were previously ruled, and the tens, fifties, and hundreds indicated on them. Recording of these "check" vehicles was not difficult, since the recording observer, after recording nine numbers, would announce to the "reading" observer whose eyes were on the traffic, that the following vehicle would be the tenth.

If the distance over which the record is being made is short, as at an intersection, the last 3 digits of licenses will be sufficient for identification of vehicles. Using this 3-digit recording, 2 observers can record as many as 800 vehicles per hour with little difficulty.

Analysis of the information obtained requires first matching the numbers shown on the "incoming" sheets with those shown on the "outgoing" sheets and eliminating all those which do not appear on both sheets within a reasonable elapsed time. Then, since the time record on the chart is correlated with the license record on the sheets, these same vehicles may be eliminated from the chart. With the vehicles not matching removed from the record, the aggregate time for all vehicles is obtained by the summation of the "incoming" and "outgoing" times, as described in the preceding paper, and the average trip time found from this figure.

In addition to providing an accurate record of "incoming" and "outgoing" times from which an aggregate time for all vehicles may be found, this type of study, because of the possibility of identification of particular vehicles, permits a much more detailed analysis than is possible with the regular intersection analysis. For instance, it is very easy to time separately right and left turns, or to make a complete analysis of the movement of vehicles through multiple intersections.

Use of this method is not confined to intersections. It is ideally adapted to analysis of traffic on open highways. It is possible to obtain the average speed maintained over a given section of highway and how the speeds of the individual vehicles vary from the average speed. The effect of changes in traffic volume on average speed and freedom of movement can be studied. Determinations may also be made of the capacity of traffic lanes under ideal conditions, and how their capacity may be affected by grades, curves, and road widths.

To conduct such a study on the highway it is necessary only to station observers at the two or more critical points between which information is desired. The distances which may be included are dependent only on the length of wire which it is practicable to lay out for the study.

By gradual development and combination of proven

* See Public Roads, February, 1934.

methods, it is now possible to analyze accurately the movement of traffic over distances up to several miles. Practically every condition of traffic flow may be studied by some combination of the methods described.

Trailer Carries 194-Ton Load

After the completion of a severe test at Boulder City, a giant trailer for carrying the great penstock pipe from the fabricating plant to Boulder Dam has been pronounced satisfactory by government and Six Companies, Inc., engineers.

The trailer, sold by C. R. Jahn Co. of Chicago and built by the La Crosse Boiler Co. of La Crosse, Wis., is believed to be the largest ever built. It is 37 ft. 8 in. long and 22 ft wide. The frame is of fabricated steel built up on two 33 in. beams. It is mounted on 16 wheels supported by eight axles. Each axle carries two wheels with two tires to the wheel, making 32, 28x14 tires. Axles are of the tilting, oscillating type to care for road irregularities and assure a level platform and balanced load.

All 16 wheels are steered by hydraulic pressure. Pressure is furnished by a Northern Nytroalloy steel pump driven by a 15 hp. motor. Control is provided by a steering wheel on a platform at one end of the trailer.

Trailer with Its 194-Ton Load

A compensating link between the two main steering levers makes it possible to steer the wheels on the inner arc of a curve at an angle suitable to the angle of the wheels on the outer arc and assure a rolling action to all 16 wheels.

Air brakes, of the internal expansion type actuated by Bendix Westinghouse air brake mechanism, assure instant control. Safety features provide for the application of the brakes should the hauling unit be disconnected. The air compressor is an Ingersoll Road type 30, which delivers a maximum pressure of 200 lbs. to each of four storage chambers at the four corners of the frame. Hauling may be done from either end and drawbars are provided. Thus the trailer does not need to be turned around at the end of the trip.

The test of this huge unit was held near Boulder City and was attended by the engineers of the United States Government, the engineers of the Six Companies, Inc., and the manufacturers. The test consisted of loading the trailer with bundles of re-enforcing rods averaging two hundred 5/8 in. rods to the bundle. The load was 194 tons not counting the timbers used in piling the steel. The trailer weighs 41 tons, making the gross load almost 235 tons.

The trailer and its load was then pulled over a roundabout road to the highway. This necessitated crossing tracks and rough terrain, a feat that amply demonstrated the flexibility and strength of the machine and prompted its unqualified acceptance by the engineers.

The delivery of the pipe to the dam has been one of the major problems confronting the government and the Six Companies engineers. Some of this pipe is the largest ever built, weighs 185 tons, and is 30 ft. in diameter. It is 2¾ in. thick and made of six plates of steel, so heavy that only three plates make a load for one flat car from the steel mill to the fabricating plant. The trailer and this great load must travel over a road 1½ miles long, blasted out of the mountain side, to the dam site where it will be unloaded by the permanent government cableway and lowered to the penstocks hundreds of feet below.

New $75,000,000 Argentine Government Highway Program

According to a report of Jan. 26 from U. S. Vice Consul Douglas Flood, Buenos Aires, the Argentine Government on Jan. 25, approved a road construction program to be carried out during the next two years, which will involve the expenditure by the National Government of $75,048,012 and the employment of 70,000 persons. In addition to this sum $6,360,000 will be spent for repair work, and $22,048,000 are to be contributed by the various provinces although the total sum includes projects started in 1933.

The principal features of this project are trunk roads from Buenos Aires to Bahia Blanca, Buenos Aires to Cordoba, and Buenos Aires to Corrientes. It also includes the construction of numerous minor roads and bridges. The Government estimates that of the total amount appropriated, only $4,000,000 will be spent outside of Argentina. Most of this will go for steel reinforcements and the balance for the purchase of paving materials and road building machinery.

The total appropriation of 177,000,000 pesos (peso 42.4 cts.) will be apportioned approximately as follows: Labor, salaries and cartage, 118,000,000 pesos; local materials including production labor, 16,500,000 pesos; foreign materials and equipment, 8,000,000 pesos; railway freights 13,000,000 pesos; sundry expenses, financial services and contractor's profits 21,500,000 pesos.

The plan provides for an expenditure of 133,444,000 pesos by the National Roads Board over a three year period (including 1933) to which will be added 44,000,000 pesos of "Federal Aid" funds. Of this amount the Board has available at this time about 74,000,000 pesos, and it is intended to provide the balance by means of a bond issue and the assignment of Federal funds previously allotted to the Provinces of Sante Fe, San Luis, and Jujuy. 43,000,000 pesos represents construction begun in 1933, and it is expected that bids will be called for on the remainder of the roads within the next three months, since practically all of the preliminary surveys have been completed.

This project will affect each of the fourteen provinces and ten national territories, including Tierra del Fuego, where a half million pesos has been allotted for roads and 50,000 pesos for a bridge.

In submitting bids for construction on Government contracts, there are certain requirements which must be carefully observed. A copy of the specifications must first be published; the bid is then submitted on official stamped paper, which is generally furnished with the specifications. The bidder must be a resident of the Republic or Province, or must act through a resident representative, whose authority must be evidenced by a power of attorney. Deposits of 2 to 5 per cent of the amount of the bid are required. These are usually made in the form of provincial bonds, and are, of course returned to the unsuccessful bidders.

HOW A ROMAN HIGHWAY *Was Built and Was Used*

A TRIP over the Appian Way, the most famous road of ancient Rome, may be experienced in mind in viewing the model of that enduring highway prepared by the U. S. Bureau of Public Roads. Methods of building the road are shown in detail as well as authentic facts about the traffic on the highway. Extended and careful investigation by the Bureau disclosed exact information as to the design of this most famous highway in history, typical methods of construction, and the various types of traffic on the road.

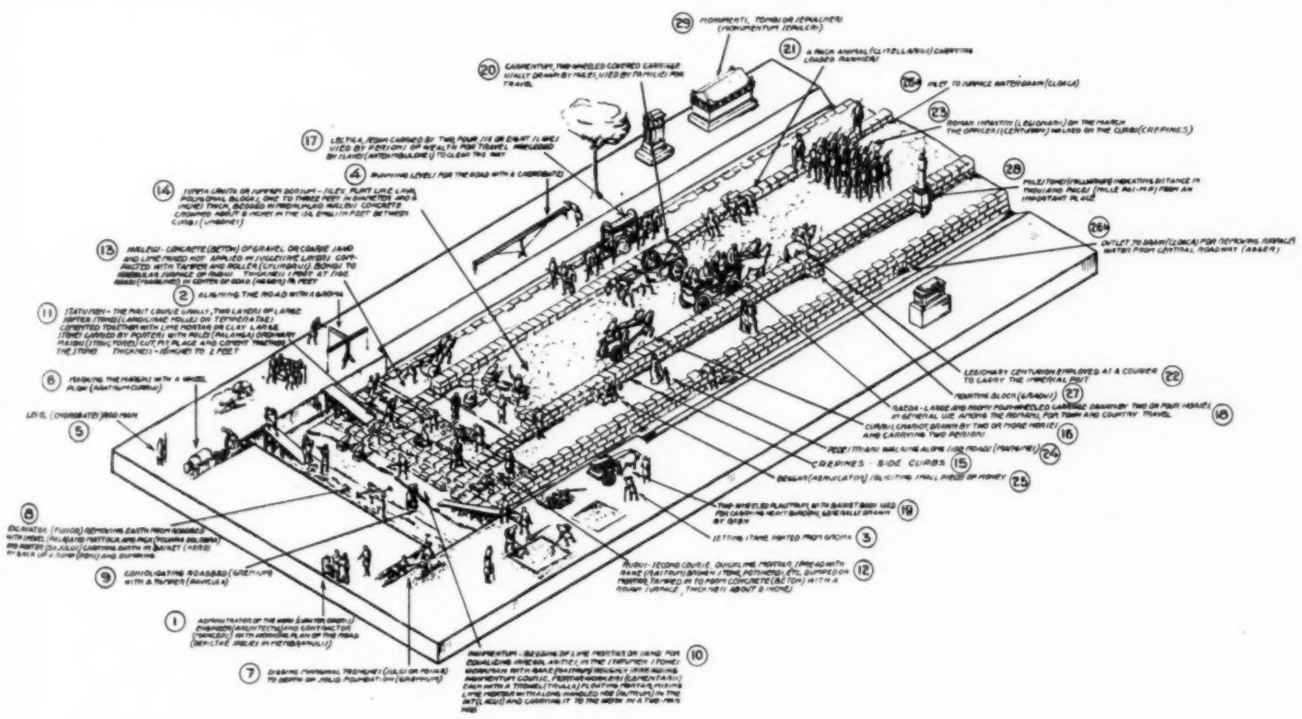
In the foreground of the model, at (1) may be seen the administrator of the work (curator operis) discussing ways and means for building the road shown on the plans (depictae species in membranulis). The other two men in the group of three are the engineer (architectus) and the contractor (manceps). At (2) one of the engineer's assistants may be seen aligning, with a groma, a stake held by another assistant at (3). Another member of the surveying party is shown at (4) running levels with a chorobates while his assistant holds a leveling rod, for him to sight on, at (5).

This model is designed to show a typical condition of a roadway built upon comparatively firm upland terrain. Where marshy regions or generally unstable foundations were encountered the Roman engineers first built a framework of carpentry, called contignata pavimenta. The frame itself was called contignationes. The joints or sleepers were termed coaxationes or cessationes and were made of an oak called aesculus, because it was not susceptible to warping or shrinkage. To protect this timber from the destructive effect of the superinmposed lime mixed with other materials, they covered it with a bed of rushes or reeds, or sometimes straw. Upon this stratum of reeds or straw was laid the statumen or foundation and the remainder of the construction proceeded in the same manner as on the firm ground with the exception that the total thickness of masonry seems to have been reduced in order to lessen the dead load of the roadway upon the marshy subsoil.

Excavation of the Foundation.—Upon solid ground the margins of the roadway were marked by two parallel furrows of a wheel plow (aratrum currus), as shown (6), about 40 ft. apart. Following the location of these furrows, two parrallel trenches (sulci or fossae) were excavated (7) to determine the nature of the subsoil and the depth to a solid foundation (gremium). The excavator (fussor) used a shovel (pala) and a mattock and pick (fussoria dolabra). Then the excavators aided by a porter (bajulus), shown at (8), with a basket (aero) upon his back, removed the earth between the trenches to the level of the roadbed (gremium). A ramp (pons) was used by the porter for reaching the elevation of the undisturbed ground surface.

Consolidation of the Foundation.—Where unsuitable material was encountered, it was removed and replaced with firm subsoil which was thoroughly tamped with the beetle (pavicula) indicated at (9). If a firm bed could not be obtained thus, wooden piles (fistucationes) were driven into the foundation. The roadbed (gremium) was then carefully shaped and leveled to receive the surfacing materials. Even where the excavation revealed a comparatively firm foundation, the subsoil was always carefully rammed with the pavicula before proceeding further.

Bedding Course.—Upon the roadbed, prepared as described above, there was spread a bedding course of sand from 4 to 6 ins. in thickness, or mortar about 1 in. thick, made of lime and sand or hassock (soft, calcareous lime-



Key Sketch of Isometric Projection of Model of Appian Way, Showing Construction Methods and Vehicular and Foot Traffic.

Model of Appian Way Constructed by the Bureau of Public Roads, U. S. Department of Agriculture, and Now Permanently Located in the Arts and Industries Building of the National Museum in Washington, D. C. The Appian Way Was One of the Main Roads of the Great System of Highways of the Roman Empire. Its Construction Was Started in 312 B. C.

stone). This bedding course, called the pavimentum, and indicated at (10), accommodated the irregularities in the undressed lower side of the stones used in the first course of masonry called the statumen. While spreading the pavimentum layer, the mortar worker (cementarius) sat upon a stool (sedecula) in order to better use his long trowel (trulla). The mortar probably had been spread first to a uniform thickness with a rake (rastrum). The lime (calx) was slaked in a pit (lacus) beside the road and later mixed with sand, to form the mortar with a long-handled hoe (rutrum). Meanwhile another pit of lime was being slaked. The mortar was carried to the road with the aid of a two-man hod. The water for slaking the lime was brought to the pits in earthenware jars upon the heads of the water bearers. Sometimes V-shaped wooden troughs were used to transport the water from the source of supply.

Statumen.—Into the pavimentum was bedded the statumen or first course, as shown at (11). This course consisted of two layers of flat stones cemented together with well-tempered lime mortar. None of the stones was permitted to be of a size smaller than would fill a man's hand and the largest of the stones were ranged along the sides of the causeway to act in the nature of a retaining wall. Where lime mortar was not available, the stones were cemented together with clay. The statumen varied in thickness from 10 in. in good ground to 2 ft. in bad ground. Since the purpose of this course was to supply solidity, almost any kind of stone was used depending upon its local availability. The softer stone used in the statumen and even in the two next courses, the rudus and nucleus, was called lapidicinae molles or temperatae to distinguish it from the lapidicinae durae, or hard stone, reserved for the wearing surface (summum dorsum).

Ordinary masons (structures) placed the stones for the statumen course. For cutting the stone they employed the chisel (scalprum) and mallet (malleus), iron wedges (cunei) the adze (ascia), and the saw (serra). Masons also used the trowel (trulla), the mortar bucket (fidelia) and the level (ascia). The heavier stones were suspended by cords from poles (palangae) passed over the shoulders of the porters. For moving the heavier stones into position they had the crowbar (vectis).

Rudus.—This second bed, shown on the key sketch at (12), was made of broken stones smaller than those used in the statumen, and mixed with lime. Isidore, the Greek architect of the sixth century, who completed the Church of Saint Sophia at Constantinople, called material of this character—rudus. When this layer was composed of stones freshly broken, it was called rudus novum and to three parts of stone there was added one part of quicklime. When however, the aggregate came from old buildings, it was called rudus redivivum, and then an additional portion of lime was used in the ratio of two parts of lime to five parts of aggregate. The work was then termed the ruderatio. The beetle (pavicula) or rammer was used to strengthen, equalize, and smooth it. This layer whether formed of gravel or debris, was 9 in. in thickness after being thoroughly rammed.

The first step in laying this course consisted in spreading a layer of mortar over the statumen with a rake. The gravel or debris was then dumped upon the mortar and pounded into it with the beetle. The mortar was used in such a quantity that voids remained in the surface of the gravel or debris to which the next layer (nucleus) would form a substantial bond. Where the aggregate for this work was transported for a considerable distance, they probably employed for this purpose the two-wheeled plaustrum, a vehicle with a basket body, used for carrying heavy burdens. It was generally drawn by oxen.

Nucleus.—Into the interstices left in the surface of the preceding course (rudus), there was bonded the third layer called the nucleus, shown at (13). It was cement mortar or beton, composed of gravel or coarse sand and lime used hot, that is slaked lime. This layer was sometimes called the pudding or pap but more commonly the nucleus or kernel. This nucleus was placed in successive layers each compacted with a roller (cylindrus). On the side margins the nucleus was about 1 ft. thick and in the central agger the thickness was increased to 1½ ft. to form the crown. Into this freshly-laid mortar was

bedded the wearing surface or summa crusta. The nucleus material formed the wearing surface for the side roads or margins which were at lower level than the central roadway or agger.

Summa Crusta or Summum Dorsum.—This wearing course called the summa crusta or summum dorsum, illustrated at (14) was bedded in the freshly laid nucleus within the agger or central portion of the roadway between the side curbs. The high crown, of about 3 in. in 16 Roman feet (15½ English feet) between the side curbs (crepidines) was designed to facilitate the passage of the projecting hubs of chariots and the surface drainage of rain water. Side drains (cloacae) (26a and b) were provided at intervals through the side curbs crepidines) and under the margins to the side ditches (fossae).

Especially on important roads like the Appian Way the summa crusta was made of hard, durable, wear-resisting stone like silex, or flint-like lava. This stone was placed in the form of pentagons, hexagons, or irregular polygons from one to three feet in diameter and some 6 in. in thickness. The upper surface was dressed smooth but the bedded under side was left rough. The joints were fitted so closely as to be scarcely discernible. This type of masonry was known as opus incertum. Where the volcanic silex was not available, other hard stones were used instead, dressed and laid in the same manner. Occasionally the surface of the road was made of concrete. On some of the roads, block of schistose stone were laid on edge, like Belgian block. This type of construction has been found upon a portion of the Fosse Way in Britain. On the less important roads the surface was made frequently of gravel.

Side Curbs (Crepidines).—The side curbs or crepidines, shown at (15), projected 18 in. above the margins, and were 2 ft. wide. They were built upon the foundation of large stones extending through to the statumen. At intervals there was placed, against these side curbs, a mounting block (gradus) (27), to facilitate mounting upon a horse.

Dimensions of the Appian Way.—The total thickness of the four courses described above varied from 3 to 4½ ft. in dimension. The over-all width of the Appian Way at the surface was about 36 ft. Cross sections of the road as given by Edward Cresy in 1856 and Alfred Leger in 1875 are almost identical.

Typical Traffic.—The chariot, located at (16), was probably the vehicle most commonly used by the ancient Romans. Although it found its greatest use as an instrument of war, the lightness of its construction made it suitable for rapid transportation upon the roads. It had two wheels, was built to hold the driver and another person, and was drawn by two or more horses. The choice of the other vehicles ranged from the luxurious litter (lectica) illustrated at (17), through the humble raeda (18) or family coach, and still more humble wagon or plaustrum (19). The lectica was carried by slaves with the aid of poles probably run through rings attached to the body of the litter or perhaps attached by cords or thongs. The litter bearers were usually Syrian or Cappadocian slaves, dressed in bright red traveling cloaks often made of fine wool from Canusium. For this reason they were called canusinati, and also lecticarii. In and near the cities slaves preceded the lectica to clear the way with the words "Give place to my lord." These harbingers were called anteambulones.

The carpentum (20) was a covered two-wheeled carriage used by families for travel and by women on state occasions.

The pack animal (clitellarius) located at (21) illustrates the poor man's method of traveling with a small amount of baggage in panniers supported by the pack saddle.

Not only slaves and freedmen but also two grades of scouts, and legionary centurions were used as messengers to carry the imperial post. The figure shown at (22) is a legionary centurion.

The Roman infantry (legionarii) on the march, as at (23), could walk either in the central roadway or upon the side roads. The side curb provided an excellent walk-way for the commanding officer (centurio).

Near the villages and towns there were to be found the customary pedestrians upon the highways, as illustrated at (24).

The curb stones were the favorite resting places for the beggar (aeruscator) (25) according to Juvenal who asked a poor client if he could find no vacant curbstone or bridge rather than endure the meanness of a rich patron.

Milestones.—The Romans placed milestones (milliarium) (28) along their principal highways, spaced 1,000 Roman paces apart (4,861 English feet). In the vicinity of Rome these milestones represented the distance from the golden milestone (milliarium aureum) erected by Augustus in the Roman forum to mark the origin of all the great military roads. Beyond 100 miles from Rome and in the provinces the milestones showed the distance to the nearest principal town.

Monuments.—Outside of Rome and the larger cities the roads for long distances were bordered with monuments, tombs, and mausoleums. The latter, no doubt, were relegated beyond the walls of the city for reasons of sanitation.

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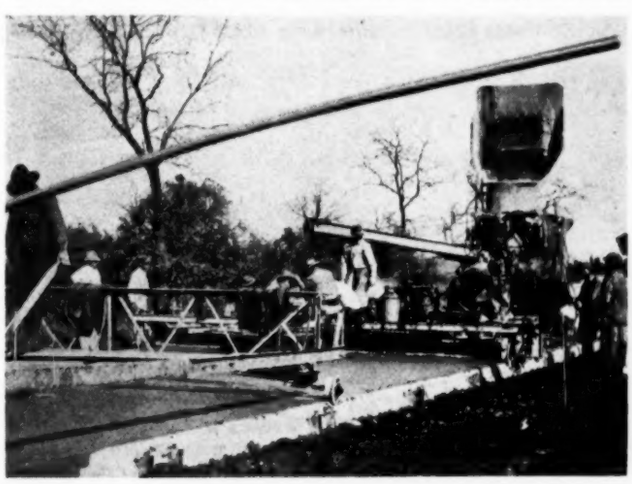
Concrete Road Smoothed in Direction of Traffic

This concrete highway in Pawnee County, Oklahoma, is being constructed with the aid of a working force of 100 men. The interesting feature of this picture is the use of the longitudinal float operated lengthwise of the road from a bridge. This method of floating the concrete surface of this public works highway, built partly within an Oklahoma city, makes sure that any corrugations of the surface are parallel with traffic on the road. The finishing machine and the concrete mixer appear in the background. This work, begun September 30, is under the supervision of the Oklahoma State highway authorities and the U. S. Bureau of Public Roads.



The Longitudinal Float Is Operated Lengthwise of the Road.

New CWA Fund and Street Improvements

USE of CWA funds for street construction, reconstruction and improvement has been widespread —has given many cities long-wanted and much-needed improvements.

With Presidential approval of the new fund, $450,000,000 of additional money is available for CWA projects. This must be spent by May 1.

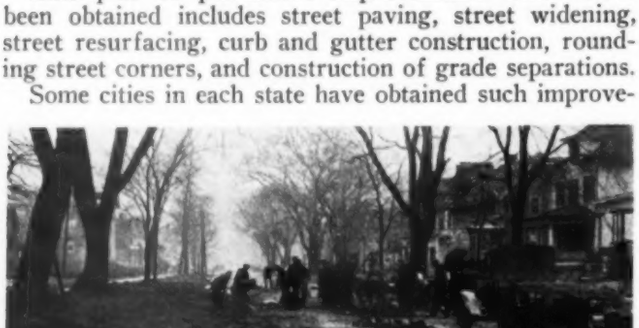
C. W. A. Street Widing on 5th St., Mt. Carmel, Ill.

Cities have immediate opportunity to obtain needed street improvement—an opportunity that has very definite time limitation—they must act at once!

There is an endless variety of ways in which CWA money has been spent. But there is no sounder use than in modern streets.

Examples of permanent improvements which have been obtained includes street paving, street widening, street resurfacing, curb and gutter construction, rounding street corners, and construction of grade separations.

Some cities in each state have obtained such improve-



Widening Corner and Street at Fairfield, Ia., for Parking; C. W. A. Work; 6-in. Slab to Curb

ments during the past three months. Many other cities and towns would benefit by pressing for such improvements from the new fund.

The need for street improvements is quite apparent. Recognition of this need as a Federal problem was given in the PWA appropriation for roads, which allocated not less than 25 per cent to be spent on city streets.

An example of such an improvement is work on Hylan boulevard, Borough of Richmond, New York City. Early in 1933, 30,000 lin. ft. of an 8-ft. earth park strip

Widening Concrete Pavement on Hylan Blvd., Staten Island, New York City, with Cement Bound Macadam. C. W. A. Work Giving Employment to 600 Men.

between two lanes of concrete was paved with cement bound macadam with relief labor.

When CWA funds were made available, advantage was quickly taken of the opportunity to continue improving Hylan boulevard. Application was made for funds to widen, by 14 ft., five additional miles. For many years the Borough will enjoy the benefits which it has gained from a sorely needed improvement.

Use of CWA funds for permanent improvements has resulted in public acclaim on many occasions. Other uses, particularly where the work created nothing of lasting value, have been the center of widespread public criticism.

Communities desiring the most from their CWA allotments will find street improvements ranking among the foremost in the list. But immediate action is necessary if such improvements are obtained from the latest appropriation.

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Half of Minnesota's Highways Now Dirt or Gravel Surfaced

More than half of Minnesota's trunk highway system now consists of gravel or dirt roads. Prior to the recent expansion of the system, about one-fourth of the trunk highways were gravel or dirt, the remaining three-fourths being bituminous treated or paved.

This situation is shown by a check made by state highway engineers on the 4,356 miles of county roads taken over by the highway department this year. Mileages of the various types of road now in the system are:

Untreated gravel, 5,043 miles; bituminous treated gravel, 2,690; dirt roads, 826; paved, 2,555. This makes the total mileage of the new system 11,114 miles. The total mileage before expansion was 6,759 miles.

Of the new roads taken into the trunk system, 778 miles were dirt roads, 3,300 miles were graveled, 228 miles were bituminous treated gravel and 49 miles were paved.

It is estimated that the counties have been spending more than $1,000,000 a year on the 4,356 miles of roads added to the state trunk system, according to the highway department. This expense from now on will be met from revenues of the state highway department, and will be lifted from the tax burdens of the counties. Funds of the highway department were not increased to meet the additional expenses, but, on the contrary, were severely decreased.

Planning a Highway System to Meet Future Requirements

By E. C. LAWTON
Assistant Commissioner, Division of Highways, N. Y. State Department of Public Works

"PLANNING a Highway System to Meet Future Requirements" implies the ability to forecast future events. There are two methods of forecasting: One is "Guessing" and another is "Estimating." Every industry of magnitude is constantly confronted with the necessity of forecasting future events and estimating future requirements. The Highway Industry is no different from other types of industry, except it is more difficult to determine a unit of measurement to express the magnitude of the demand. Where other industry anticipates demands for its products as so many tons and adjusts its facilities accordingly the Highway Industry can only make known its demands in terms of money. As soon as we discuss money there immediately arises the spectre of increased taxes, which is a handicap at the outset. Later in this paper therefore I have evaluated the benefits of highway transportation in terms of money in order to make direct comparison of costs of the highway commodity.

Expressed another way, we should distinguish between demand and desire. I believe there is still a great desire for improving highways but it is being suppressed or held back by fear on the part of the taxpayer that further improvement of highways will result in increased taxation. This fear is aided, abetted and fostered by those who are opposed to highways, such as railroads; by other branches of government who seek to maintain their appropriations at the expense of highways; by those who now have sufficient highway service for their immediate and selfish needs and last but not least by a vast population which has no authoritative information or which has been misinformed or only partly informed by propaganda.

Some Questions for the Railroads.—Typical of the concern of railroads is a pamphlet entitled—"Who pays for Highways in New York State?" by Dr. C. S. Duncan, Economist, Association of Railway Executives. This pamphlet purports to be an analysis of highway expenditures and sources of revenue and asks the question—"Are land owners, private motorists and city vehicle owners paying more than their share?" You are invited to speculate as to the interest of the railroad in the welfare of the land owner, the privte motorist and the city vehicle owner. I believe it had a rather wide distribution among Chambers of Commerce and other similar bodies throughout the state last winter. I would not be surprised also if it finds its way to the desks of many of our legislators.

In another part of this pamphlet (page 6) it is stated that "highway transportation in the state of New York has failed to pay the construction and maintenance of its roadway, as to state highways by $268,276,518." I will later include in my data a reference to the cost of construction and maintenance of the state highway system. At this time, however, I believe it pertinent to ask several questions:

How many railroads in this country have ever paid for their construction cost?

How much revenue was derived by railroads from vast land grants given by our government as subsidies for construction purposes?

Has any of the taxpayers' money which was given as vast subsidies to our railroads, ever been paid back by such railroads even when they were in the enviable position of showing net earnings or profits?

Has any public money the railroads themselves collected from hamlets, villages, cities, etc., as a grant or direct subsidy to locate railroads through certain areas ever been repaid to any one?

The point I am getting at is—the railroads have seldom, if ever, paid back to any one the initial cost of construction. As one artery of transportation, therefore, why should they expect another artery of transportation to repay such costs on highway when they have never been repaid by railroads. This attitude seems rather inconsistent especially in view of the fact that many of them are now seeking aid from the government either in the form of loans or in the form of grants to pay for the entire cost of grade crossing eliminations. If the latter becomes an accomplished fact there would be no decrease in taxes, in which railroads profess to be vitally interested, but a further diversion of them to help build railroad structures.

While I mentioned above at least four reasons for apparent lack of highway demand, I am somewhat at a loss to classify the activities of a Federal highway agency (not legislative) which advocates that the taxpayers of New York State, for instance, should pay 100 per cent of the cost of grade crossing elimination. We as citizens and taxpayers of the state feel perfectly competent to decide that matter for ourselves. Such a statement of opinion may be permissible so far as they apply to Federal funds, but the wisdom on any one attempting to establish a national basis of taxation which would compel the residents of any state to pay certain costs unless concurred in by taxpayers of the state itself is open to serious question.

An Indirect Method of Eliminating Truck Competition.—Much thought by those in the first group seems to have been expended in trying to convince the public that the construction of pavements of sufficient stability to carry trucks, is an unwarranted expenditure of public funds.

While this may be a mooted question it would appear that agriculture, industry, and every inhabitant of the State would be adversely affected if pavements were to be constructed only for automobiles. In other words, it is contrary to the public interest. Furthermore, the Federal Government itself when it first entered the highway construction field used as one of its arguments the necessity of providing arteries of highway transportation for purposes of national defense.

How ridiculous it would be to construct one-half million miles of trunk highways so thin or so inadequate that it would only be possible to drive a team of mules and a wagon load of ammunition over them and not be able to move the artillery or other equipment for which the ammunition is intended. How ridiculous it would be to the farmer, for instance, if he was compelled to get

out and bolster up a bridge in order to move a thrashing machine or traction engine before he could move to his neighbors.

Assuming that every conceivable commodity was compelled to use the railroad for its transportation it would still be necessary to distrbute such commodities from railroad stations to consumers. Is it logical to expect the distribution of such commodities from the latter point to the consumers in the back seats of automobiles? It seems fairly obvious that the railroads are abandoning their previous direct opposition to trucking and are now pursuing the indirect method of trying to restrict the construction of pavements in such a way as to eliminate the truck from our highways.

The Selfish Desire of Various Groups.—In the second group we find public officials everywhere besieged by this group and that group to maintain their particular appropriation else dire things will befall the state or nation, as the case may be. Certain groups, not content to advocate their own cause, even go so far as to suggest that their appropriations be maintained by money taken from highways and devoted to their cause. This, in spite of the fact that highway transportation is about the only governmental service which shows a profit and for which a special revenue is exacted in the way of tolls or taxes from a special group of its citizens, namely, highway users.

Most of the reasons advanced in favor of a particular activity are general in character, but I believe, if it became necessary, every state could point to past appropriations for governmental activities, such as education, say in 1925, and find such appropriations much less than those now requested. At the same time, during any of these past years, it could not be said that our young manhood and womanhood were neglected or that their education was being sacrificed. Certainly if their needs were met in past years by lower appropriations, they would not unduly suffer if their present needs were restricted to past figures rather than to maintain extravagant appropriations at the entire expense of other public activities.

It is not the purpose of this paper to advocate the continuation of highway improvement at the expense of any other state activity. Such a presentation is unnecessary for the reason that total governmental expenditures are not being decreased but are, in most instances, being urgently and greatly increased for the worthy purpose of providing employment. Supreme efforts should, therefore, be made to provide useful employment and this can best be done by intelligent long-range planning.

Some two years ago thoughtful men of vision led by our then governor and now president were advocating a comprehensive plan so that our social and industrial lives might be safeguarded from abrupt changes, changes which in the past have carried us from the heights to the depths and back again, leaving vast wreckage in their wake. Due to its magnitude, highway improvement may rightfully take its place as a major industry and should be included in any plan designed to stabilize production and employment. I believe, therefore, it is incumbent upon the respective states to provide a plan and for the benefit of those assembled, I am taking the liberty of outlining a suggested plan.

Broad Studies of Future Highway Program Needed.—Any study of a future highway program should be broad enough and comprehensive enough to include all public highways and streets in towns, cities and villages, as well as a review of the revenues of the state. An effort should be made to get a comprehensive picture of a complete highway transportation system and its effect on economic conditions, with particular reference to the taxpayer and the unemployed.

The intelligent "Planning a Highway System to Meet Future Requirements" will require at least a general transportation survey and general economic survey of the state. With these as a basis you will have sufficient information to plan future developments.

A transportation survey, to be of most value, should embrace not only the volume and distribution of past and present traffic but should also include a past and present history of the state highway industry. In other words, it is important to know not only the size, volume and distribution of vehicles but also to know something about the track on which the vehicles run. The type, width, first cost, length of life, replacement cost, carrying charges and maintenance cost of pavement and roadbed must be known in order to make intelligent estimates for the future.

Much of this type of information may be available in various records in state departments. Such information will require, therefore, research and assembling. It happens in New York State that nearly all of it can be determined for the 12,000 mile state highway system from existing records of the Department. However, there are all told about 81,000 miles of public highways in the state, the balance being under the supervision of the county, town, village or city, as the case may be. It is obvious, in the latter group, that we have only partial information and it is in this particular field that a transportation survey is extremely valuable.

Combining Future Developments with Past Experiences.—"What has been done" is of utmost importance as from it you will discover many things to do or not to do in the future. Every large industry shapes its future course by combining expected future developments with their experience in the past. Certainly the highway industry and the highway transportation system which serves directly 2,340,000 motorists in New York State and over 20,000,000 throughout the Nation, is entitled to the same consideration as any other going concern of like magnitude. What has been done in each state will, no doubt, vary widely from New York State. On the other hand, what has been done in New York State may represent a parallel situation and some portions of it may be directly applicable to portions of other states. For that reason I am taking the liberty of including a brief resume of the industry in New York State.

Improved highway history in New York began in a very limited way with an appropriation of $50,000 in 1898 and culminated with an expenditure of $60,000,000 during the year 1931. The total expenditures for construction and reconstruction of highways and bridges through 1932 was $553,317,563.82. In the November, December and January issues of the "Low Bidder," I published a complete history of finance and construction of New York State highways. Due to the magnitude of the undertaking and for the sake of clarity, I subdivided it into three periods—Past, Present and Future. As you may wish to refer to such publications for more detail than time permits in this paper, I will adhere roughly to the same practice.

Nineteen Twenty the Dividing Point.—The year 1920 has been selected as a dividing point between the past and present for the reason that it marks the beginning of the so-called "reconstruction era"; the exclusion of the second fifty million dollar bond issue and the necessity of giving more scientific consideration to the problems of highway design and construction on account of the rapidly increasing motor vehicles registration in the state.

About this time there was also a rather marked trend or tendency of heavier and more rapidly moving vehicles. This trend to a greater weight of vehicle was much more destructive to pavements than formerly on account of greater impact shocks. The alignment and grade of our highways increased accidents to motor vehicles and their operators. There was a marked increase in the density of traffic which has since constantly increased, as evidenced by the fact that in 1920 there were 95 motor vehicle registrations per mile of improved highway and in 1932 there were 195 motor registrations per mile of improved highway on the state system. About 1920 very little information was available as to the amount of travel the different highways were carrying.

Through 1920 there was expended about $103,000,000 for construction and $45,000,000 for general maintenance. The latter funds were direct annual appropriation. The former consisted of two fifty million dollar bond issues and $3,000,000 direct appropriation. At the end of 1920 there were completed 7,374 miles of two-lane pavement. At that time there were 682,919 motor vehicles registered in the state. There was collected $7,746,420 in automobile registration fees in 1920. The first appropriation for maintenance was $730,000 in 1907, at which time there were 1,787 miles of completed pavement and the automobile registration was only 13,895 motor vehicles—an appropriation of $55 per vehicle.

The "Present" of the New York Highway Industry.—From 1921 through 1932 I have considered the "present" of our Highway Industry. In addition to the above reasons, there also occurred a very important step in the highway policy of the state. It was in about 1922 that the state determined on a definite policy of financing future highway improvement from current appropriations and current revenues. It became evident to those responsible for the fiscal affairs of the state that the carrying charges, interest and amortization of any further bond issues for highway purposes would become so great that a large part of future revenues and appropriations would have to be set aside for interest and carrying charges of any bond issue method of financing highway work. This decision, coming at this particular time, no doubt, has saved the taxpayers of the state a very large sum of money. Perhaps it is not strictly true that this is a saving in a sense that the money was placed in the bank, but it did result in getting a much larger mileage of improved highway per given dollar of revenue than could otherwise have been accomplished.

Much criticism has been directed to the fact that the first two bond issues were permitted to extend over a 50-year period, as the roads would be completely destroyed before the bonds could be paid. While there may be a logical objection to long-time bond issue methods of financing, it should be borne in mind that when we entered the reconstruction era (financed jointly with maintenance and repair) in 1920, the roads which were reconstructed actually took the place of those which were built by Bond money and a large percentage of the original investment from the bond issue funds was preserved. In other words, none of the highways in New York State have been reconstructed from the proceeds of a bond issue. This would seem to be an adequate justification, if one is necessary, of the method adopted by the state in about 1922 of financing not only reconstruction projects but construction projects from current appropriations and current revenues.

The legislative and executive branches of government having determined upon a policy of pay-as-you-go and by further providing for the imposition and collection of a motor vehicle registration tax, later supplemented by a gasoline tax, presumably to be devoted to highway purposes, it became incumbent upon the highway engineer to revise or establish a practice in the highway construction industry, based upon a scientific investigation of the various engineering features entering into work of this character. Highway policy had to be determined mostly from a study of past performance and an intelligent estimate of the probable future requirements of highway transportation. Motor vehicle registration was not only increasing by leaps and bounds but the area of normal operating distance of vehicles was greatly increasing. We were not only confronted with an increased motor vehicle registration but an increased distance of travel per vehicle. Industry quickly availed itself of the use of highway transportation which was then and which continues to be better adapted to its needs, both in door to door service and more rapid transportation.

State Traffic Censuses Begun in 1922.—In order to obtain suitable information and keep in step with a tremendous increase in traffic, the state began in 1922 to take an annual traffic census on all of its highways on the state system. This 12-hour count is usually taken the second or third Saturday in August and at the same point on the highways each year. It is also taken on the same day throughout the state. Thus we obtain a reasonably accurate distribution of traffic on that particular day and an indication of it on other days. This general traffic count is frequently supplemented by special counts in different localities as our needs may require. We also found that a traffic census is very important in grade crossing separation work in order to establish before the Public Service Commission the hazards at various highway railroad grade crossings throughout the state.

Each year a graphical traffic census map is prepared. As a result of a study of these maps and suitable graphs of motor vehicle registrations, the Division of Highways, in 1928, prepared a so-called widening map. On it was shown all of the highways on the state system, those particular routes on which the pavement should be widened to three or four lanes by the year 1940. A resurvey and review of this widening map was made in 1933 to test the accuracy of our previous estimate. It was found in only one case where a three-lane width had been estimated it should be reduced to two lanes; while in three cases a two-lane estimated width was increased to three lanes. At the beginning of this paper I stated that a complete transportation survey should be made and I do not imply that our annual census maps are complete enough for a comprehensive study. On the other hand, as I review the past ten years, I can assure you that these maps have been of untold value to the highway commissioner and the taxpayers of the state. With a knowledge of the state, it is almost alarming how closely an experienced highway engineer can approximate conditions in any given case. With them, for instance, we have completely demonstrated the savings in operating costs to motor vehicle users of the state system. Likewise we can reasonably estimate future traffic on the state system.

Determining Volume of Traffic.—To obtain precise information concerning volume of traffic, it should be counted at every highway and street intersection throughout the state, but the cost would be prohibitive. Sufficient accuracy may be obtained by the adoption of a skeleton system on which is located different types of counting stations (master, key, base, etc.). We have observed, in a limited way, certain relationships between different days of the week. In order to save time, I re-

fer you to an excellent outline for this kind of work adopted by the State of Illinois. It is a report of the Survey of Traffic on Illinois State Highways—August, 1931 to Labor Day, 1932, in two parts—Part 1 and 2, each dated December, 1932. They found, among other things, that:

Traffic volumes during each day of the week are practically identical from Monday to Friday, inclusive.

The Saturday volumes averaged 1.15 times the weekday flows.

The Sunday volumes averaged 1.65 times the weekday flows.

In February, the month of minimum traffic, the vehicle movement is 53 per cent of that in August, the month of maximum traffic.

It is quite probable that your relationships may not coincide exactly with those that were discovered in Illinois. On the other hand there is probably no doubt but what, as the result of a couple of weeks' general count, suitable relationships may be evident in your state. This would substantiate the reliability of certain relationships, whatever they may be. There are, however, two rather general conclusions in Part 1 of this report to which I personally would take violent exception, viz., as to what volume of traffic creates congestion on a pavement and the measure of the necessity of immediate widening. These, obviously, may be controversial points, but they will in no way affect the basic information determined as a result of a traffic survey.

Annual Savings of $79,847,000 on Improved Highways.—While we have not, at this time, in New York State a comprehensive transportation survey, we have sufficient reliable information to conservatively estimate traffic on the state system since 1922.

We are convinced that there is considerably more than an average traffic of 1,000 vehicles per mile per day on 10,578 miles of high type pavement and more than 500 vehicles per mile per day on 1,440 miles of intermediate type of pavement.

Independent investigations have shown conclusively that there is a minimum saving in operating cost of at least 1c per vehicle mile when earth roads are improved to intermediate types of pavement and 2c per vehicle mile when they are improved to the higher types of pavement. With this information we can evaluate the annual savings in cost of operation on approximately 12,000 miles of improved pavement as $79,847,400 per annum.

From 1898 to 1933 there has been expended $297,000,000 for new construction of 12,017 miles of improved highway. From 1920 to 1933 there has been expended approximately $188,000,000 (exclusive of bridges, overhead, etc.) for the reconstruction and resurfacing (of all types and widths) of approximately 5,130 miles of pavement. From 1920 through 1932 there was expended approximately $93,825,000 for general maintenance purposes (excluding betterments). This is an average of $746 per mile for a 13-year interval. (Discuss type of work that our maintenance charges cover). The maintenance costs from 1930 to date have been decreasing and in 1932 the average was $595.49 per mile. Considering maintenance cost as an annual carrying charge, but excluding it as an investment, it will be noted that the total expenditure for construction and reconstruction is approximately $485,000,000.

Savings in Operating Cost Equal Entire Expenditure on Construction.—The savings in operating cost, therefore, for the past ***six-year period would about equal the entire expenditure of the state on its state highway system*** for construction and reconstruction purposes. When we consider that the state highway system has been in existence (different degrees of completion) for at least 30 years and that the savings for the last six-year period alone equal of 30-year expenditure, it would seem that the state highway system is, without question, a self-liquidating project from the standpoint of savings in operating cost alone, without any consideration as to the *revenues* which have been derived from such a system. To the engineer-economist, it would further appear that it is not only a self-liquidating but a very profitable investment.

While the above may seem somewhat irrelevant to the subject of "Future Planning," I feel that it establishes a proper background from the standpoint of the taxpayer. It is proof that he has obtained value received for every dollar he has invested in his improved state highway system in the past. In other words, if you cannot justify past experience, there is very little need for anticipating future expenditures.

Average Pavement Life 24.4 Years.—The above historical data furnishes valuable and reliable information that may be used in estimating future costs of construction or reconstruction, future carrying charges, such as maintenance, etc., and a rather complete answer to the question as to what is or should be the "normal expected life of pavement." For instance, the average rate of reconstruction or resurfacing in New York State from 1920 to 1932 was approximately 400 miles per annum. On the basis of average completed mileage during this time interval this amount of reconstruction indicates an average pavement life of approximately 24.4 years. This is probably a little too long a life on our main trunk line system, as we are hardly keeping apace with our real needs. However, I believe it fair to assume a pavement life of 20 years on the primary system and approximately 25 years on the secondary system.

Status of Improvement on All Public Highways.—In connection with your transportation survey, you should obtain reasonable information on the status of improvement or unimprovement of all public highways in the state. From the best information available, we found the status of improvement in New York State substantially as follows:

Types	State	Counties	Towns	Cities	Villages	Approx. Total
Concrete	.....	.....	.....	.....	.....	.....
Brick	.....	.....	.....	.....	.....	.....
Stone block.....	.....	.....	.....	.....	.....	.....
Wood block.....	6,096	1,043	366	.....	.....	7,505
Macadam Pen...	3,204	6,897	1,352	.....	.....	11,453
Macadam mix. method	1,278	.....	.....	.....	.....	1,278
Waterbound	1,164	1,922	2,294	.....	.....	5,380
Gravel	137	1,819	13,066	.....	.....	15,022
Misc.	138	.....	.....	.....	.....	138
Total improved..	12,017	11,681	17,078	6,986	3,212	.....
Unimproved	1.545	6,108	35,286	3,727	2,323	.....
	13,562	17,789	52,364	10,713	5,535	.....

In New York State we have three maior classes of rural highways, viz., state, county and town, and two classes of urban highways, viz., city and village streets. Incidentally, they are under the direct supervision of five different agencies, which partly explains the lack of information on some of the system, and therefore, the necessity of a comprehensive study of the entire transportation system in the state.

Determining Cost of Future Rural Highway Program.—Having assembled the data on the status of all streets and highways in the state, the next problem is to determine what parts of the remaining system are worthy of improvement. In many localities the feeling seems to

be prevalent that we now have too many highways. Probably this is because a majority feel that they have all the highway service they desire and the minority, therefore (as is typical of our type of Government), must prove its case. At any rate the question has been asked or will be asked—"Are we over-highwayed?" To the fairminded and unbiased mind, the reply must be in the negative. *Technically,* we are not over-highwayed until every inhabitant is *reasonably* served with an improved highway. *Practically,* we should build every highway it is economically proper to construct. Let it be said, at this point, it is economically proper to improve every highway which will show a saving in transportation cost equal to or greater than the necessary carrying charges for construction, reconstruction and maintenance.

The ultimate cost of a future rural highway program may be listed as follows:

1,545 miles	×	$25,000	= $38,625,000
6,108 miles	×	15,000	= 91,620,000
28,000 miles	×	6,000	= 168,000,000
Total			$298,245.000

Determining Savings from Improved Highways.—The next step is to estimate the additional savings in motor vehicle operating costs that would result from an improvement of the 35,653 miles above mentioned. Applying the same method of analysis on the state, county and town systems, there would result the following estimated savings:

1,545 miles	× 800 vehicles	× $0.02	× 365 days	=	$ 9,022,800
6,108 miles	× 400 vehicles	× .01½	× 365 days	=	13,376,520
28,000 miles	× 100 vehicles	× .01	× 365 days	=	10,220,000
Total					$32,619,320

If we consider the $298,245,000 estimated cost of a future highway program as an investment, we may then consider the savings in operating cost as a measure of the wisdom of making such an investment. The estimated annual savings of $32,619,320 per annum (considered as a profit) would yield a return of 10.9 per cent profit on the investment. An interest rate of 10.9 per cent has been considered a profitable one for the past 30 years of improved highway history and no doubt will continue to be considered profitable for some years to come. In addition to the tangible investment values, there should be added the intangible benefits of enhanced property values, etc., which have been pointed out in connection with the highway system already improved.

Of course, the assumptions made will vitally affect the results and conclusions. For these very reasons such assumptions and estimates should be reliable and conservative and should be made by the most competent and experienced highway engineers.

In public works, as I have previously indicated, there is no accurate yardstick by which to measure the profit or loss to the stockholders. However, one's achievements may be measured and judged on the basis of whether or not the benefits derived are commensurate with the cost. It would seem from the above the State of New York is amply justified in continuing to improve its highway system for some years to come. The *rate* of improvement and reconstruction is dependent, of course, upon the availability of funds for such purposes. I think it is a well-established fact, both in industry and public works, that economy in expenditures can only be obtained by following out an orderly and well considered program (especially on large scale work), as opposed to proceeding on a hit and miss or wasteful basis. In our state funds are made available generally in February or March for the same construction season as it requires about a year of time in which to initiate a project, make surveys, designs and estimates and let it to contract. This means that we have to estimate as nearly as we can six or eight months in advance of actual appropriations in order to have plans ready to let to contract. This is only one example of the economy in long range planning.

Highway Program Would Furnish Employment.—Probably one of the most outstanding benefits of a highway program, at this time, would be the opportunity of gainful employment that may be afforded many thousands of workmen on needed self-liquidating and profitable projects. Such highway projects could easily be of a character which would endure as an investment of 100 per cent value to those who pay the cost thereof. Highway work is widespread in its nature, well-suited to reach all communities and actually takes work to the workmen instead of requiring workmen to congregate in our industrial areas which are so overcrowded at the present time. For example, the amount of work that could be provided for labor from a highway expenditure of $40,000,000 would be approximately $36,000,000 to be paid directly and indirectly to labor. This sum, on a basis of 50c per hour, will provide 72,000,000 man-hours of gainful employment, which means that approximately 48,000 men could be directly and indirectly employed during a construction season on the basis of a five-day week, six-hour day, or thirty hours per week, which is the standard set up by the present National Industrial Recovery Act. The question might well be asked—What other industry or what other activity of the state would give an equal amount of work with a corresponding useful return to the taxpayer?

It should be done in order that the public may be informed of the benefits which have accrued and will further accrue by a further improvement of highways. The benefit of saving in cost of motor vehicle operation accrues to every motorist, every taxpayer and every resident of the state. It applies equally to the city man and to the rural resident—the city man and rural resident profit by lower transportation cost and lower cost of commodities. From the standpoint of pleasure and business, the city man also uses the state highways to a greater extent than the rural resident. Many other benefits could be cited, such as enhanced value of property, especially that adjacent to the improved highways, and increased benefits to the social, religious and educational well-being of all communities. Improved highway transportation facilities have made possible the consolidated schools and greater educational opportunities to the coming generations. It also brings many benefits to the rural resident in the way of decreased cost of medical attention and a larger field for social welfare work, with a corresponding improvement in the general health of the citizens of the state. Many of these benefits are real and many others could be evaluated by a comprehensive and properly directed study of the state. It should be done so as to stabilize the state highway industry and preserve the investment value of millions of dollars in contracting equipment, in sand, gravel and stone quarries, steel mills, cement mills, asphalt plants, tar plants, etc. Each of these groups, which are necessary in order to make a cohesive industry, employ many thousands of men in the field of industry, as well as transportation.

The "Planning of a Highway System to Meet Future Requirements" to be carried to a logical conclusion must include a study of the ability of the state to finance such a program. This, in turn, is dependent upon the sources and distribution of highway revenues, general revenues, etc., available to the state. To obtain information of this character, an economic survey is very

necessary. In New York State much of this information is available in a "Report of the State Tax Commission," which is a document of about 370 pages and quite comprehensive. The bulk of the work on economics would consist of a review and segregation of different items of indebtedness, etc., their rearrangement and presentation in such a simple manner as to be easily understood by the general public. A condensed form of such a study should be able to answer what proportion of highway revenues of various types are collected from residents in different localities, and what proportion of various highway revenues are expended for work in those localities. One of the conclusions being sought is to determine what distribution of these revenues will be just, economically sound and for the greatest public good.

Another field of investigation is to obtain similar information for revenues and taxes other than highway revenues.

I would like to emphasize this sentence for the reason that there is a growing school of thought that motor vehicle taxes and motor fuel taxes are *not* special taxes. In other words, the motorist represents a cross-section of the residents of the county, state or nation, as the case may be, and the taxes they pay are no more a special tax than would be an excise tax or a tax on real property. This school of thought, however, may have lost sight of the matter of equity. While the tax of the highway user is proportional to his use of the highway, such tax is *not* proportional to the benefits he derives from the Government. Let me illustrate by saying that possibly 75 per cent of the motorists in the state of New York receive a salary of less than $3,000 per year, yet they would pay as much motor vehicle and gas taxes as those with incomes of say fifty thousand dollars and upwards. To be economically sound, taxation should be based on the principle of paying in proportion to the benefits received. Such benefits are usually measured by wealth. The existence of a large number of automobiles on the road *does not* represent the wealth of the state or nation.

The Bureau of Public Roads at Washington has recently co-operated in economic surveys in the states of Wisconsin, Michigan and Illinois. The work has been carried out with such thoroughness as to inspire confidence and contributes materially to the success of an undertaking of this character, which is so essential to the development of a rational highway program. I think it is safe to assume that the Bureau of Public Roads will continue to co-operate in the manner above outlined and it is recommended that you take advantage of such an opportunity.

It should be borne in mind that a complete report of an economic and transportation survey is so voluminous as to lose its interest to the general public. It is very important, therefore, that such a report be summarized or condensed in such a way as to be easily understood by the individual citizens, newspapers, legislative and civic groups.

How to Overcome the Present Opposition.—In conclusion it should be said that, as fear is the cause of the difficulties confronting the highway industry, truth must be the remedy. Two methods of spreading the truth are open to you. The first is a suggested transportation and economic survey to bring out the facts. Lacking this opportunity the next most practicable method is publicity to bring out the facts. Publicity to be most effective should emanate from one and only one large organization which has the entire highway industry at heart. At present there are innumerable groups, each sending out fragmentary truths, the effect of one being lost before another is placed before the public. We might well draw an object lesson from railroads. Let us bring together our construction department, our maintenance department and our operating department into one large organization. Then let us go a step further than the railroads and include the taxpayer.

The construction and maintenance department will include manufacturers of cement, asphalt, tar, sand, stone, gravel, steel, etc., and allied interests, with their vast number of employes, who depend on employment afforded by such industries. The operating department will include the manufacturers of automobiles and trucks, the producers of lubricating oils and gasoline, garage men, the owners and operators of over twenty million motor vehicles throughout the United States, and those who depend upon them for employment.

While each of these interests may now have their respective associations, their efforts are mostly centered on the *trade* directly affecting their immediate business. The problem herein discussed is somewhat removed from their immediate interests but with the present trend of highway revenues to other channels than highways, those interests which now seem far-fetched may easily become immediate, acute and probably disastrous.

If such a single organization could be formed, the present indifference and opposition would be completely overwhelmed. It merely lacks a concentration of effort to accomplish such a result. It is recommended that the Association of Highway Officials of North Atlantic States be authorized to offer assistance towards accomplishing this end.

Acknowledgment.—The foregoing is an address delivered February 14, before the Association of Highway Officials of the North Atlantic States.

Bridges and Grade Separations Are Important in Road Program

Bridges and grade separations on highways, recommended in the National Industrial Recovery Act, as needed to reduce traffic hazards, were on Jan. 31 a substantial part of the public works highway program, according to the Bureau of Public Roads, U. S. Department of Agriculture, which is administering the $400,000,000 earmarked for public works highways by the last Congress. This fund was approximately divided in the act between roads on the Federal-aid highway system (50 per cent), extensions of main routes through municipalities (25 per cent), and secondary or feeder roads (25 per cent). The state highway departments are carrying out the actual construction of these bridge and grade separation projects, using grants of money from this fund.

Bridges over 20 feet in span with their approaches were approved or under construction in 2,746 places to be built at an estimated cost of $37,384,843. Of these bridges, 1,753 were on the Federal-aid highway system, 243 were on extensions of main routes through municipalities, and 750 were on secondary or feeder roads.

Grade separations between railroads and highways under way on Jan. 31 totaled 194. Of these projects, 107 were on Federal-aid highways in the country, 62 on extensions of main routes through municipalities, and 25 on secondary roads. The estimated cost of these railroad-highway grade separations is $7,814,524.

Grade separations between intersecting highways totaled 12 at an estimated cost of $793,990. Of these, 5 were on the Federal-aid highway system and 7 on extensions of main routes through municipalities.

EDITORIALS

This Alleged Industrial Revolution

THE daily press for nearly a year has been telling us that we are in the midst of a new industrial revolution. Possibly so. But, if so, it is the first industrial revolution brought about by political action. For that reason we are very skeptical as to the alleged "revolution" that America is supposed to be experiencing.

From the year 1300 to about the time when the Declaration of Independence was signed there was no marked increase in the real wages of the average worker. Hence there was no industrial revolution during those five centuries. Of political revolutions there were plenty, but each one left the average man as poverty stricken as ever. Our own War of the Revolution was in no sense an industrial revolution, but it happened to occur shortly after Watt had invented the first economic steam engine. That invention marked the beginning of the "power age," and therefore of the greatest industrial revolution of all time.

The census of 1849 is the first American enumeration of both the number of our people engaged in gainful occupation out of the total horse-power of prime movers. There were about 7 million people thus engaged in 1849 and they had at their disposal about 14 horse-power each. Eighty years later, in 1929, we had about 50 million people in gainful occupation and they averaged 82 horse-power each at their disposal, not including the power available in about 25 million automobiles. Since those engaged in gainful occupation were very nearly 40 per cent of the population, both in 1849 and 1929, it follows that the per capita horse-power that served industrially increased nearly 500 per cent between 1849 and 1929. That was an industrial revolution by the side of which all the political revolutions throughout all history sink into insignificance.

Since each mechanical horse-power exceeds 10 men in capacity to do work, the average worker in 1929 was virtually assisted by 820 slaves.

The Chicago *Tribune* recently gave this striking illustration: If it were possible to utilize their muscular power in printing that daily paper, it would require 100,000 men. Their wages at $5 a day would make that muscular power cost 52 cents per copy of the paper printed, whereas the electrical power costs only 0.06 cents per copy. In other words muscular power at $5 a day costs 900 times as much as the electrical power costs in that instance.

Governor Pinchot of Pennsylvania, who poses as a great political reformer, has been telling the public that most of the electric companies in America are operated by "pirates" and that in the aggregate those companies overcharge the public $500,000,000 annually. If they are "pirates" now they have been much more "pirates" in the past, with Edison himself as their Captain Kidd for half a century. The preposterous statements of Governor Pinchot are amazing to engineers who know the facts, and they must sound pretty fishy even to the man who has only his common sense as a guide. Governor Pinchot is of the type that seeks to effect an industrial revolution by political means. He seeks "what ne'er was" and probably ne'er will be.

The only industrial revolution worth designating by that name is the one that began scarcely a century and a half ago, founded on applied science and most successful in those countries where it was least interfered with by politicians. We commend to our Pinchots a study of industrial history. It will not be found either in school or college text books, for theirs is political history mingled, as Herbert Spencer long ago pointed out, with biographical gossip.

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Unjustified Attacks Upon the A. R. B. A.

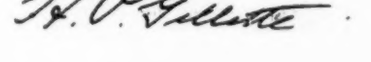
IN an editorial entitled "Wanted—A Highway Association" Engineering News Record of February 1st says that the American Road Builders' Association "has neither the organizational structure nor the inspiration to accomplish a real task." The editorial declares that "An American Highway Association is needed, a self-supporting body of definite purpose whose platform is the efficient development and operation of a highway network that will best serve the public.

Reader of "ROADS AND STREETS," and of "Good Roads," which has been merged with "ROADS AND STREETS," know that, from its inception, one of the main objects of the American Road Builders' Association has been the "development of a highway network that will best serve the public." Our readers also know that no other organization has been either so effective, or so persistent in bringing about state and federal road building. Without state and federal aid, road building today would be almost at a standstill. Yet both federal and state aid were editorially opposed by Engineering News until they became established facts. That opposition was mainly based on the argument that "pork-barrelism" would result if highway appropriations were made by federal or state legislators. The American Road Builders' Association espoused federal and state aid from the beginning, and if that Association had never done another thing in all its long history, its existence would be abundantly justified.

At the present time that Association is engaged in trying to prevent diversions of the gasoline tax. What other association is effectively aiding the A. R. B. A. in this work?

In its issue of Feb. 22 Engineering News-Record continues its editorial attack on the A. R. B. A., but in a milder way. It even suggests that perhaps the A. R. B. A. may reform and become the ideal highway association that its February 1st issue pictured. We quote: "Can the American Road Builders' Association beget in itself the elements fundamental to that vigor which is now indispensable? Has the association the vision to see and the spirit to carry out the labor of recreation? Unless it has, it cannot measure up to the job that needs to be done, and it is sure to perish. If it has it must prove its intention and its faith by its works. Failing in prompt action it cannot ask that the highway business shall continue to wait in patience while it follows an opportunist course of leisurely reform."

The A. R. B. A. "proved its faith by its works" many years ago, and at a time when Engineering News was opposing state and federal highways. So it comes with rather poor grace from Engineering News-Record to belittle an association whose earlier work was largely responsible for the present volume of highway expenditures.



County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

Low Cost Stabilized Road Construction In Onondaga County, N. Y.

By R. B. TRAVER

County Superintendent of Highways, Onondaga County, New York

IMPROVEMENT of the primary and secondary road systems of our county have been completed and represent about one-third of our total mileage. Up to the present time very little thought has been given to the balance of our mileage, comprising about 1200 miles. We have about concluded that the forgotten man was the farmer residing on this major part of our road system. He is entitled to the same advantages as his distant neighbor living on the primary or secondary system, and as a result of our change, we have been able to improve in less than two years more than double the county road mileage, which had previously taken us twenty years to build, thereby relieving our forgotten man.

Close Up View of Completed Road Surface.

New Plan Formulated in 1932.—The policy of Onondaga County, up until 1932, had been to concentrate all efforts on concrete construction. However, in 1932, the Board of Supervisors deemed it necessary to formulate a new plan, due to the unemployment conditions existing. The demands were, in short, a low cost construction giving maximum expenditures of money on labor and not over 10 per cent on materials; also that 1,000 men be put to work, which was three times the normal force previously employed by the county for highway purposes. Unless these conditions were fulfilled, it was evident there would be little or no money appropriated for road use. These requirements eliminated concrete construction, and thus, generalities and methods built up from years of concrete experience were useless. It was necessary to start again with nothing but theory and common sense to produce a road that would meet these demands. After much consideration of different plans, and with foresight for the future, a method of stabilized gravel stage construction was approved, which involved putting all the care and effort into grading and drainage that had been previously put into these same items for concrete road construction. We thus developed a satisfactory, stable farm to market road, which in the future, all conditions being favorable, could easily be converted into a higher type surface, it being understood that these roads should be maintained until such time.

This plan is in accordance with the extensive development work of the Bureau of Public Roads. We may clearly define a stabilized gravel road as one that will give proper support for wheel loads, will not become slippery in wet weather, and will not ravel or become dusty in dry weather. Such a surface must combine coarse aggregate, fine aggregate, silt, clay and calcium chloride.

Preliminary Work.—Before any actual construction is started, our proposed gravel roads are surveyed for alignment, topography, and cross sections are taken. From this data the office works up new alignment, new grades, and balances the dirt. All curves 8 degrees or sharper are banked ½ in. per foot on the curve proper. We have a standard section, which is used for all our construction, shown in the illustration. It is 26 ft. between shoulders, with a ditch 28 in. in depth below center line grade. It is a known fact that our ample drainage has been an important factor in the success of our roads.

Material in the Wearing Course.—We are now ready for actual construction, and first is the clearing and grubbing work, followed by the laying of permanent, ample culverts. Then follows the ditching, the material from which is used in building our subgrade. The rough grading is completed, being bladed and rolled, if necessary, to form a stable smooth surface. Guard rail is placed at the necessary points. All the work is done by hand labor, except for any blading and rolling necessary. We are now ready for our wearing course and the best type of material would be gravel of the following composition:

50 to 60 per cent of gravel above a 10 mesh screen.

10 to 20 per cent of coarse sand above a 40 mesh screen.

10 to 20 per cent of fine sand through a 40 mesh and retained on a 270 mesh screen.

10 to 20 per cent of silt and clay through a 270 mesh screen.

The soil fines passing the No. 40 screen should have a plastic index from 8 to 12. The plastic index of a material is a measure of its ability to resist passing from a plastic state to a liquid condition by its absorption of

water under certain conditions. It is expressed in percentage of water by weight that is necessary to bring about this change, or it is the difference between the liquid limit and the plastic limit. The liquid limit is the maximum amount of water expressed in percentage by weight that a sample can contain without flowing together when lightly jarred under certain conditions. The plastic limit is the minimum amount of water expressed in percentage by weight that a sample can contain and still be rolled into sticks or threads ⅛ in. in diameter.

Typical View Showing Road Before Starting Construction

Any material which can stand this test must have considerable cohesive properties, and must contain a certain amount of clay. Now, we can state that the plastic index is the measure of the cohesive properties of a soil.

The function of the gravel is to supply rigidity and high internal friction. It also adds to the mechanical stability of the road surface. Coarse sand serves the same purpose as gravel and also locks the gravel in place. The fine sand fills the voids in the coarse sand. The silt has high capillary properties and serves as a reservoir for calcium chloride. It contributes nothing to the roads stability and has no cohesive properties, whereas the clay supplies cohesion and toughness and fills the voids completely, making the road surface impermeable. It also serves as reservoir for the calcium chloride.

For a theoretical balance and characteristics, we refer you to the United States Department of Agriculture, Bureau of Public Roads, "Reports on Subgrade Soil Studies." We have given much study to the data presented in the Bulletin, but find it highly technical, and to be practical, much common sense must be used. Gradation plays a very important part in the materials for this class of road, and also the binder must be given consideration. However, we have not found it necessary to insist on the *close* gradations or in keeping the plastic index within the *narrow* limits in the materials at their source, and have produced excellent wearing courses without elaborate mixing.

Soil Conditions in the County.—Onondaga County covers an area of approximately 780 square miles. It is flat and sandy in the northern part, and rolling and hilly in the southern portion, with a gravely clay soil. Although gravel beds are numerous throughout the county, none of the material can be considered as ideal, it being either too coarse or to fine. Often it is without sufficient binding material to permit a good compacted wearing surface, and frequently contains an overabundance of large stones. There are also several crushed stone plants in the county, and run of crusher screenings have been used successfully in the construction of several roads.

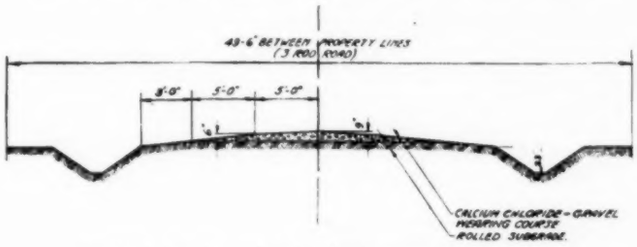
We have found subsoil that we felt was very good, but never have we found one which met text book perfection, and this is also true with our gravel beds. However, our business is building roads, and lamenting poor conditions will not impress our Board of Supervisors. They prefer results.

Construction of Gravel Surface.—We use bank run gravel, selected mainly because of nearness to the construction. There is, however, a visual inspection supplemented by simple field tests, and in a few cases where there was more than one bed in close proximity, an analysis has determined the choice of beds. The gravel is loaded on the trucks by a shovel and hauled to the job where it is rough spread by the tail board of the trucks. The gravel is then spread to a 9 in. depth at the center, 6 in. depth 5 ft. from the center, and to a feather edge 10 ft. from the center, giving a 20 ft. gravel surface.

The large stones are removed from the surface by raking, and the surface is shaped by blading, followed by rolling and honing, filling depressions and cutting off humps. The riding qualities are built into the road at this stage. The rolling is done from the edges toward the center, and after a thorough compaction the road is opened to traffic for a period of from 10 days to two weeks. During this time, if there are any unfavorable peculiarities or characteristics of the gravel, they will show themselves, and we must correct them.

Remedying Unfavorable Conditions.—The most frequent unfavorable conditions are an excess of coarse material, which may be gravel with low binding properties, and that of having an abundance of fine material or a surface with too much clay, which causes a slippery road. The first condition is remedied by blading or scraping some of the shoulder dirt over the surface of the gravel, or by placing a layer of shale sand on the surface which weathers, giving a clay binder. The clay condition is corrected by spreading the road surface with 1 to1½ in. of limestone chips, or with a clean sand. By these two remedies, we have been able to correct practically all of our difficulties.

Use of Crusher Run Stone.—In one or two instances,



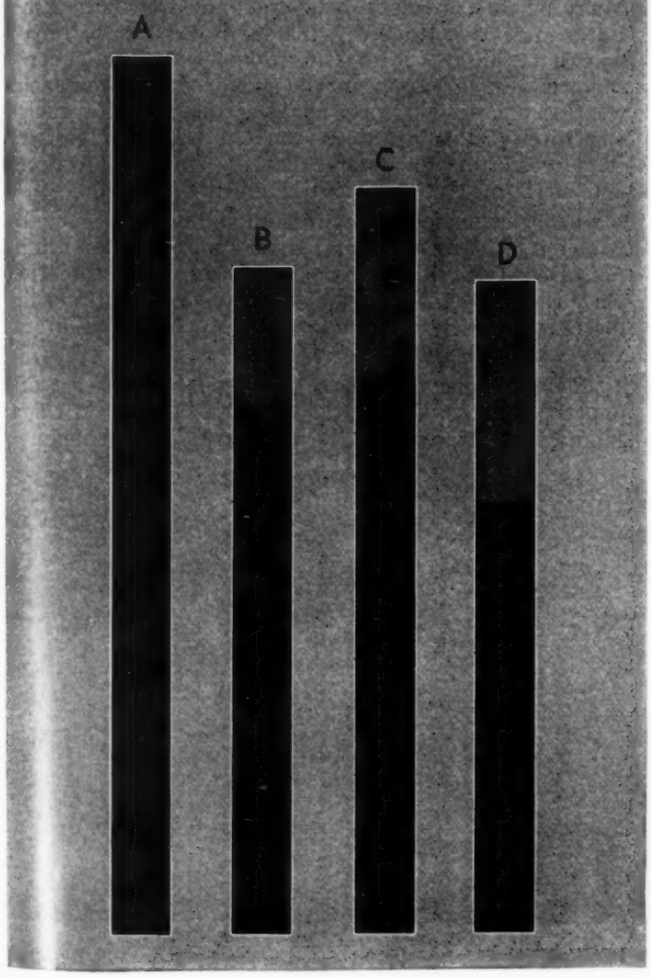
Typical Section of Stabilized Gravel Type Road

where we have not been able to procure any gravel, we have resorted to the use of crusher run from a nearby stone quarry. This product contains soil, dust, screenings, and No. 1, 2, and 3-A stone. In each case we predetermined the qualities which were lacking by a thorough examination and were able to supply the necessary material from the road subgrade. Sufficient of the latter material was windrowed along both sides of the road, so that when the crusher run was spread on the subgrade we were able to bring the soil on top by the use of graders, and to thoroughly mix these materials with drags or harrows. These simple operations were sufficient to produce a product which met all the requirements of a stabilized material. For our standard section we use 1711 cu. yds. of gravel per mile of road. Where

(C) Stanolind Cut Back Asphalt contains 65 to 80% by weight of bitumen and 20 to 35% of petroleum diluent.

(D) Emulsified asphalt contains 50 to 75% by weight of bitumen and 25 to 50% of water emulsifying agents and preservatives to prevent freezing.

about ASPHALT



The chart at the left illustrates the difference in footage of pavement which could be constructed with the same number of gallons of Petroleum Asphalt Cement, Natural Asphalt, Stanolind Cut Back Asphalt, Emulsified Asphalt.

(a) Represents Petroleum Asphalt Cement.

(b) Represents Natural Asphalt.

(c) Represents Stanolind Cut Back Asphalt.

(d) Represents Emulsified Asphalt.

Showing Application of Calcium Chloride

crusher run was used, only about 800 tons per mile were placed at a cost of 15 ct. per ton in our trucks.

Treatment with Calcium Chloride.—Our road surface is now a smooth, compact tread, and from all visual appearances, a stable satisfactory surface. However, should traffic be permitted to use the surface for any extended length of time, the condition would soon result in a rutty unstable, dusty road. The surface must be kept moist to give satisfactory service. We accomplish this by a treatment of calcium chloride, spreading it with an ordinary lime spreader drawn by truck, as illustrated. We spread 1½ lb. per square yard, or 8.8 tons per mile, the center strip receiving a heavier application due to the greater depth of gravel.

We find that it is not necessary to wait for favorable conditions of moisture or dryness to apply the calcium. The average daily mileage per truck is about 5 miles of complete surfacing. The average cost of the initial treatment of our roads is $240 per mile. Our complete stabilized treated wearing course costs from $1,750 to $2,250 per mile.

The action of the calcium chloride is to supply the needed moisture necessary to bind the soil fines into a well compacted stable surface. In wet weather, the chloride is driven farther into the wearing course, and is utilized in the dry periods following, coming to the surface by capillary action. It is very hygroscopic, absorbing the atmosphere, and its presence in the soil reduces evaporation from the surface. Our grades have run as high as 10 per cent and over, and the gravel is held just as firm as on the level surfaces with no indications of erosion or raveling.

Maintenance Methods.—As yet it has not been necessary to add maintenance gravel. Our maintenance consists of honing the surface as required, and retreating the surface with calcium chloride once or twice each year. We have found that one pound per square yard applied in the spring and from ¾ to 1 lb. applied during the summer is sufficient. Honing is usually done following rains, so as not to waste chloride. We find that infrequent honing, possibly two or three times a year, is all that is necessary for the majority of our roads. However, on some roads, where the travel is in excess of 800 vehicles per day, it is necessary to hone the surface about every four weeks. Honing is a small item in the maintenance cost. Our general spring scraping is done with an Austin No. 77 Grader. It will cover 5 miles of surface per day at a cost of less than $5.00 per mile. After this, any honing done during the rest of the season is with a Walter Snow Fighter, using the rut scraper as the blade. We do not maintain a floating surface or a loose mulch, and for this reason it is not necessary to give the surface the daily maintenance usually given to gravel roads. Present indications are that additional gravel will not be necessary for several years, as the loss from the surface is very small.

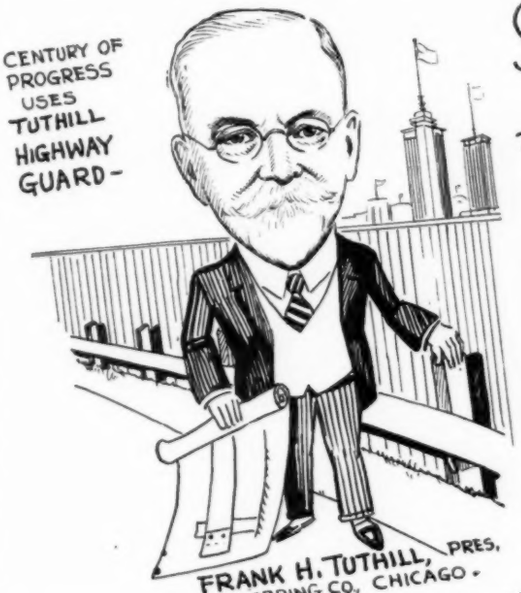
In 1932, we constructed 50 miles of stabilized gravel roads along with finishing up some concrete projects already begun. This construction was so satisfactory that the 1933 program was wholly concentrated to this gravel type road, so that by the end of 1933 a total of 335 miles had been completed employing as high as 6,000 workers. Many of these roads will be maintained as satisfactory Farm to Market Roads. Others will prove to be important thoroughfares in the future and warrant a concrete surface. In such an event, the stabilized, well compacted wearing course will form an ideal subgrade for such a structure, so that a thinner concrete slab may be used. It is reasonable to assume that the saving in concrete will offset the initial cost of laying the gravel.

In conclusion, let me impress on you not to become bewildered by such terms as Plastic Index, Liquid Limits, Soil Density and Hygroscopic Moisture. Put in their place the pebble of common sense and you will find that these terms have been unconsciously absorbed in our very simple methods.

Acknowledgment.—The foregoing is an abstract of a paper presented Feb. 13 at the 20th Annual Michigan Highway Conference at the University of Michigan.

View of Completed Road

SKETCHES AT THE A.R.B.A. STEVENS HOTEL CHICAGO

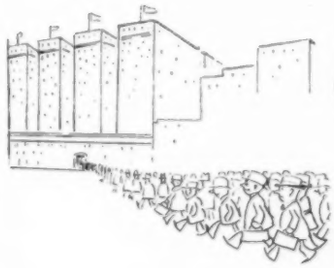


FRANK H. TUTHILL, PRES.
TUTHILL SPRING CO., CHICAGO.

"COSTS LESS TO RIDE ON CONCRETE"

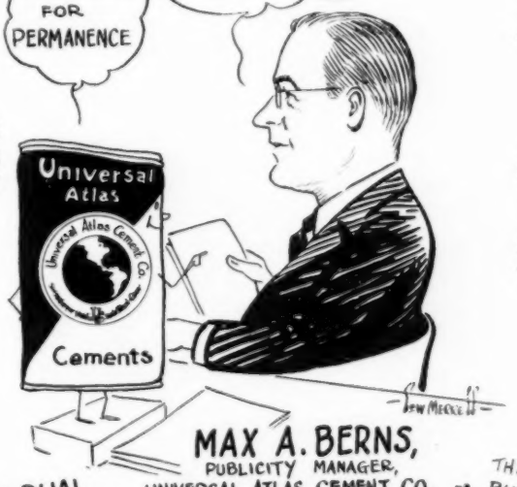
TRAVELAX-ION ON RIBBONS OF CONCRETE — "UNDER A BLANKET OF BLUE"

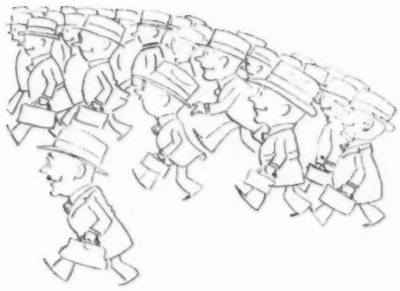
E. M. FLEMING,
MG'R HIGHWAYS AND MUNICIPAL BUREAU, PORTLAND CEMENT ASS'N, CHICAGO



CONCRETE FOR PERMANENCE

-UNIVERSAL ATLAS CEMENT FOR DURABLE CONCRETE





MAX A. BERNS,
PUBLICITY MANAGER, UNIVERSAL ATLAS CEMENT CO., CHICAGO.

AUSTIN DUAL DRIVE - IT'S MORE THAN A MOTOR GRADER

H.F. BARROWS, ADV. MG'R., AUSTIN-WESTERN ROAD MACH'Y CO., CHICAGO.

CONVENTION and HIGHWAY EXHIBIT

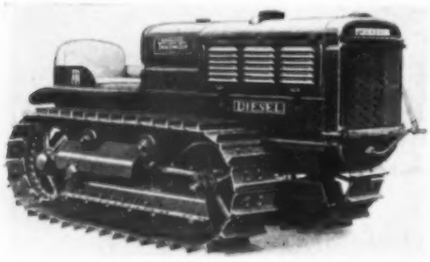
THE ONLY TRAIL BUILDER BUILT OF DYNAMIC STEEL CASTINGS - AND IT GOES PLACES

R.W. MOON,
MG'R INDUSTRIAL EQUIPMENT DIV., CONTINENTAL ROLL & STEEL FOUNDRY CO., CHICAGO.

New Equipment and Materials

McCormick-Deering Diesel-40 Tractractor

The McCormick-Deering Model TD-40 or Diesel-40 TracTracTor of the International Harvester Co., Chicago, Ill., is operated by a four-cylinder, four-stroke-cycle, valve-in-head Diesel engine and is equipped with the same type of chassis as the McCormick-Deering six-cylinder T-40 TracTracTor.



McCormick-Deering Diesel-40 TracTracTor

A distinctive system of starting makes it possible for the operator to crank the McCormick-Deering TD-40 TracTracTor engine as easily as a gasoline engine of corresponding size. To do this, a special device set by operator but automatically disengaged is employed to reduce the compression pressure and place in operation a gasoline carburetor and magneto. In starting, then, the engine is operated as a conventional gasoline engine until this automatic device cuts out and shuts off the connection to the carburetor and the spark plugs and disengages the magneto, thus restoring full Diesel pressure. The engine then operates on the regular Diesel cycle.

In building the fuel supplying system of the TD-40 engine, great manufacturing care and skill are required and dimensions must be held to unusually close precision limits. The injector pump, by-pass, and injector nozzle, for instance, are made in a special shop where temperature and humidity are carefully controlled and the air is thoroughly cleaned. The injector pumps are assembled as a unit with the governor; the starting release, and two fuel-oil filterers, and may be readily removed as such and replaced, thus obviating any need of field adjustments. Various parts of this unit are of stainless or other rust-resistant steels or are Parkerized to protect completely against corrosion.

The engine operates at compression pressures of approximately 550 to 575 lbs. per square inch. The volumetric compression ratio is 17:1. Cylinders are vertical and of 4¾ in. bore and 6½ in. stroke. The engine operates at four controlled speeds of 1,100 r.p.m. and under, and since the transmission provides five speeds the tractor may move at twenty different forward speeds—a traveling flexibility that is quite unusual. The five tractor forward speeds at full-load governed engine speed of 1,100 r.p.m. are respectively 1¾, 2¼, 2¾, 3¼, and 4 miles per hour. Reverse speed is 2¼ miles per hour.

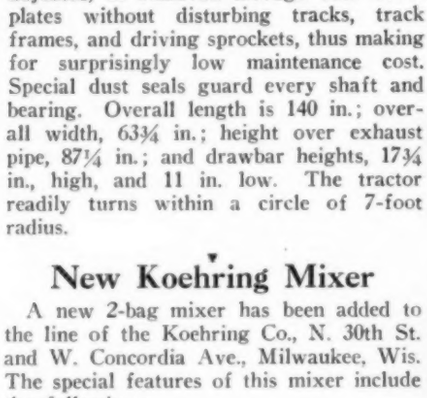
Fuel to each cylinder is filtered five times and passes through two sediment traps. Fuel-injection nozzle for each cylinder is of the closed, single-hole type. The maximum engine horsepower is 52, the maximum drawbar horsepower, 44.

The McCormick-Deering TD-40 TracTracTor is a ruggedly built crawler tractor. Accessibility of various parts is especially worthy of mention. Steering clutches and steering brakes may be easily inspected, adjusted, or removed through rear cover plates without disturbing tracks, track frames, and driving sprockets, thus making for surprisingly low maintenance cost. Special dust seals guard every shaft and bearing. Overall length is 140 in.; overall width, 63¾ in.; height over exhaust pipe, 87¼ in.; and drawbar heights, 17¾ in., high, and 11 in. low. The tractor readily turns within a circle of 7-foot radius.

New Koehring Mixer

A new 2-bag mixer has been added to the line of the Koehring Co., N. 30th St. and W. Concordia Ave., Milwaukee, Wis. The special features of this mixer include the following:

Full floating—on springs; frame only 88⅞ ins. long; only 3,800 lb.—approximate weight; equipped with anti-friction bearings; roomy skip with skip shaker; automotive type steering; accurate syphon type water tank; self cleaning water tank; fast and clean charging and discharging; axle stabilizers—centralized control; LeRoi engine—multiple "V" belt drive.



Koehring 10-5 Dandie Mixer

The free rolling drum is supported on beveled edge 10-in. rollers, solidly fastened to shafts turning in self-aligning, double row ball bearings.

Both steel tired and rubber tired wheels are equipped with full length roller bearings. The driving shaft is mounted on double-row, self-aligning ball bearings. Ball bearings are used in the gear reduction case. All of these bearings are adequately lubricated by a new type high pressure lubricating system.

All operations have been made simple and effortless. The operator can control all operations, as one man end control permits him to see both sides of the mixer. Charging, mixing or discharging efficiently handled from the drum-end of the machine.

Rubber Expansion Joints

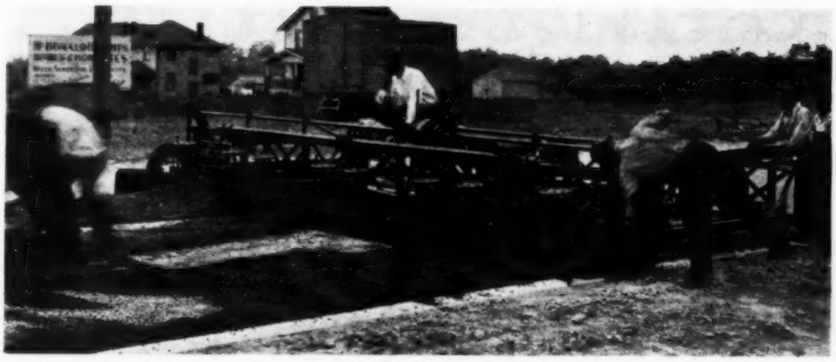
One of the interesting structural features of the new Brookpark Viaduct over Rocky River, Cleveland, O., is the use of rubber expansion joints throughout the handrail construction. Especially compounded sponge rubber, ¼-in. thick, is cemented between handrails and posts, sealing the joint during expansion and contraction of concrete. This new application of rubber has been perfected by the B. F. Goodrich Rubber Co., Akron, O.

Installing Rubber Expansion Joint

Black Top Surfacing Machine

The new black top surfacing machine of the Flexible Road Joint Machine Co., Warren, O., is shown in action in the accompanying illustration. This particular project is at McKinley Heights, O. The machine is shown running on concrete curbing of a road 20 ft. wide.

The surfacing had to be finished about ¾ in. higher than the curbing to allow for compaction by heavy rollers. For this purpose compression dollies were used. In front of the screed are four binder course strike-off plates so arranged to strike off the material 2 in. below the curbing. In case of a high spot in the road, either one of the sections would automatically rise against compression springs, but after passing, the springs force them to former positions. The binder course strike-off plates are equipped with indicators at each end—eight in number—so arranged that the op-



Surfacing Machine in Operation on Black Top at McKinley Heights, O.

erator can always see the depth at which the material is being struck off. After completion of the binder course, the top wearing course was finished with a standard black top screed, which worked on compression dollies; these dollies are adjustable so the screed can be tipped or set at any height. They also scrape off any material from the curbing so that the dolley would not have to ride over it.

Another machine was used on a black top surfacing job between concrete slabs, on Route 18, just west of Youngstown, O., the McCourt Construction Company of Akron, O., being the contractors. The same finishing machine completed both of the concrete slabs, as well as the binder and top course of black top. In building the concrete slabs, lip curbing was specified. The screed was underslung and so arranged that the concrete material was formed for the curbing in a rough manner so it was only necessary for the workman to float it with a hand float when the concrete had the proper consistency. This arrangement saved a great deal of hard labor in not having to carry back the material.

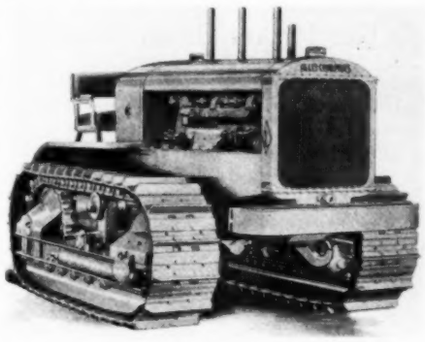
In many cases of black top work special forms are required. On one black top job under construction by the Wesco Construction Co. at Huntsville, Ala., approximately one mile of Heltzel black top forms are set ahead of the surfacing machine. The wheels of the finishing machine were arranged to operate on the forms, instead of the curbing; in other respects, the operations were similar to the other jobs described. When running curbing, the track wheels were undercut so as not to injure the corners of the concrete.

New A-C Oil Tractors

Allis-Chalmers, Milwaukee, Wis., in announcing its new "KO" and "LO" oil engine tractors, culminates over ten years of intensive study of engines that will burn cheaper grades of distillate fuel oil. These new engines are claimed to have all the advantages of the high compression type without the disadvantages.

They burn any grade of commercial Diesel fuel that is within the limits of viscosity, free from sulphur, and clean. The best fuels from which the most efficiency will be obtained are commercial Diesel oils, grades 2 and 3. These new oil engines start by either hand cranking or electric starter. This is possible because of the low compression of the engine (125 lbs.). No special starter or auxiliary engines are necessary.

Fuel oil is injected into the cylinders under pressure through the Bosch Diesel fuel pump and injectors. This fuel injection is positive and always controlled by the governor of the tractor. Ignition of the finely sprayed fuel oil is from the ordinary spark plug and time tried magneto. Positive, simple and well understood by the average operator and mechanic.



New Allis-Chalmers Oil Engine Tractor

The weights of the "LO" and "KO" are 23,000 lbs. and 11,200 lbs., respectively, in keeping with the horsepowers of the tractors. The "LO" standard is equipped with front bumper, pull hook and 20-in. track shoes.

Slackline Scraper Excavator

The Sauerman Slackline Scraper Excavator, a machine combining the most desirable features of a drag scraper and a slackline cableway, is the latest development announced by Sauerman Bros., Inc., 488 South Clinton St., Chicago.

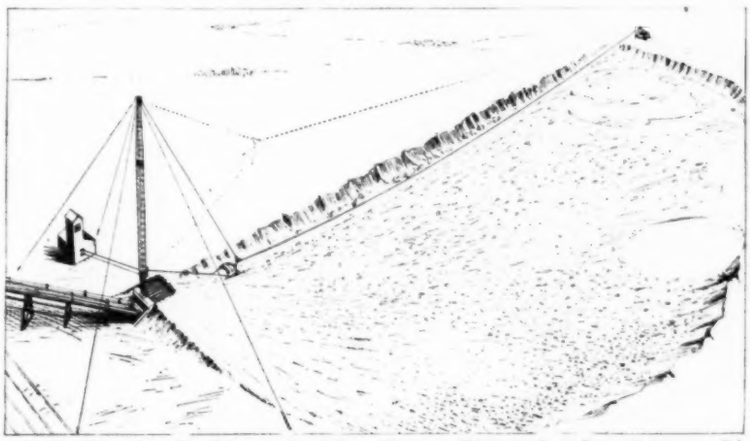
The new machine is a flexible unit capable of excavating and conveying materials distances up to 1,000 ft. at a very low cost per cubic yard.

The bucket furnished with the machine is the well known Crescent scraper. The scraper bucket is attached to a carrier which rides on a track cable. The method of operation resembles that of the standard drag scraper as far as digging and conveying is concerned, but in the dumping operation the bucket is lifted into the air by tightening the track cable and the force of gravity is utilized to carry the empty bucket back to the digging point. This speeds up the operating cycle and results in a larger hourly handling capacity than is attainable with an ordinary scraper installation where the bucket is dragged back over the ground.

When used in the production of gravel, the Sauerman slackline scraper is operated from a stationary mast. For digging canals, building levees, and similar work, the machine is operated between a traveling head tower, from 80 to 130 ft. in height, and a low tail tower. The largest of these units operates a 15 cu. yd. Crescent bucket and has a rated capacity, on its average haul, of 500 cu. yd. per hour. It can exceed this capacity under ideal conditions.

New Crane Has Flexible Drum Arrangement

A new general utility crane has been brought out by the Harnischfeger Corporation, Milwaukee, Wis. Designed primarily for faster handling of loads, one of the features of this new heavy duty crane is its flexible drum arrangement. There are two side drums and a front drum, all of which rotate independently. Each drum has three forward speeds and one reverse speed. The live, power driven boom is quickly adjustable to any desired working angle and can also be readily removed. When working conditions require, it may be changed from one side to the other by drawing the removable pins from the hinge at the boom foot.



Sketch Showing Sauerman Slackline Scraper Excavating Gravel from a Pit 1,000 ft. Wide and Delivering to Plant Hopper

The crane has three-speed traction. The high speed of 5.2 miles an hour. The intermediate speed is 2.6 miles per hour, while the low speed is 1.3 miles per hour. In lifting tests with counterweight, the machine is stated to have carried 12,000 lb. at a distance of 6 feet from the edge of the traction. Without counterweight, it picked up 5,200 lb. at 4 ft. from

New Type "Hustler" Crane

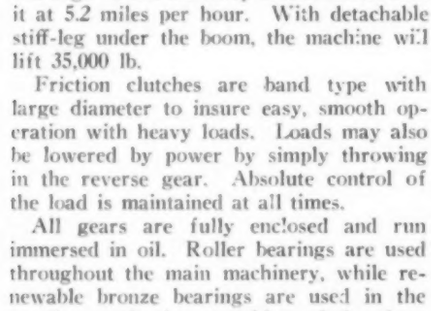
the edge of the corduroy and traveled with it at 5.2 miles per hour. With detachable stiff-leg under the boom, the machine will lift 35,000 lb.

Friction clutches are band type with large diameter to insure easy, smooth operation with heavy loads. Loads may also be lowered by power by simply throwing in the reverse gear. Absolute control of the load is maintained at all times.

All gears are fully enclosed and run immersed in oil. Roller bearings are used throughout the main machinery, while renewable bronze bearings are used in the traction mechanism to withstand the abrasive action of mud and grit.

New Small Tractor

The new McCormick-Deering I-12 shown in accompanying illustration is a small, compact, low-priced tractor that International Harvester Co., 606 South Michigan



New McCormick-Deering Tractor

Ave., Chicago, Ill., has just added to its line of industrial tractors.

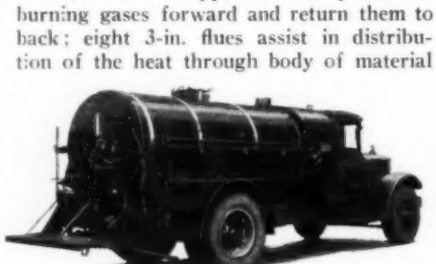
The new I-12 is 96 in. long overall, 50 in. wide over all, and 52 in. high over the steering wheel, and its turning radius is only 103 in. It has an unusually flexible speed range from a low of 2½ miles an hour up to 10¼ miles an hour, with foot accelerator and hand control. Brakes of internal-expanding type are operated by foot pedal.

Features of the four-cylinder, valve-in-head International-built engine are replaceable cylinders, downdraft carburetion, induction-type magneto, oil air cleaner, and oil filter with a metal element that may be easily cleaned. Efficient operation is facilitated by the use of seventeen ball bearings and six tapered roller bearings. Easy steering is made possible by mounting steering worm on roller bearings.

The rear axle is designed for uniform stress to withstand loads all the way across. It is semi-floating and mounted on four ball bearings; oil seals give protection against grit and dirt. Muffler, pintlehook type spring-cushioned drawbar, and comfortable spring seat are regular equipment. Accessible machined surfaces are provided for the mounting of various types of industrial equipment to be operated by the tractor. The frame is of two-piece bolted construction — transmission, countershaft and differential, rear axle and final drive gears are enclosed.

The Hvass Bituminous Distributor

The latest distributor of the Chas. Hvass & Co., 508 East 19th St., New York City, is illustrated below. The tank is elliptical in shape, and is of electric welded construction of high grade tank steel. Four 7-in. return tube type flues carry the hot burning gases forward and return them to back; eight 3-in. flues assist in distribution of the heat through body of material



Hvass Bituminous Distributor, Type 100-D

in the tank. The entire outside of the tank shell is covered with 1¼-in. rock wool.

The pump is the Viking rotary type, 4-in. suction, 3-in. discharge, capable of discharging 300 gal. per minute at 300 r.p.m. The engine is a 4-cylinder, 4 cycle, 30 HP. unit, with American Bosch magneto, Zenith carburetor, water cooled pump circulation, pressure feed lubrication, gasoline tank, radiator. Enclosed gear reduction, Twin disc clutch. Engine and pump are mounted in steel channel sills set crosswise of frame between cab and tank. Engine runs at constant speed. The heating equipment consists of two large kerosene burners of torch generating type. The distributor manifold is of the quick detachable type, and can be swung from side to side to match swath or clear obstructions. The distributors are built in several types: Type 100-D, Type 200-D and Type 500-D, and in sizes ranging from 250 to 1,800 gal. capacity. They are self-contained units which can be mounted on motor truck chassis, semi-trailer or four wheel trailer chassis. They will heat and apply any class of bituminous material.

WITH THE MANUFACTURERS

New Distributor for Domestic Pumps and Hoists

Thomas G. Abrams, Sales Engineer, representing quite a varied line of construction equipment will now handle the complete line of Domestic Engine and Pump Co., Shippensburg, Pa., including self priming centrifugal pumps, diaphragm and plunger trench pumps, pressure force pumps, road pumps, jetting pumps, hoists, etc. His address is 2411 Fourteenth St., Detroit, Mich.

C. R. Messinger Again President of Chain Belt Co.

C. R. Messinger, Chairman of the Board of Chain Belt Co., Milwaukee, Wis., has resumed the post of president of the company, left vacant by the sudden death of his brother, Clifford F. Messinger, in December. For the past three years C. R. Messinger has been president of the Oliver Farm Equipment Co., and was recently elected Chairman of the Oliver Board.

In resuming the presidency of Chain Belt Company, Mr. Messinger again takes over the active management of a company with which his name has long been associated. Joining this company in 1917, as vice president and general manager, he became president in 1923 and continued in that position through 1930. He resigned Dec. 31, 1930, to become president of the Oliver Farm Equipment Company, and at the same time became Chairman of the Board of the Chain Belt Company, his brother, Clifford F. Messinger, succeeding him as president.

Clifford F. Messinger continued as president until his death recently. During his term of office the company undertook the manufacture of three major new products —Rex Z-Metal Chain, a chain made from a new metal of high tensile strength and remarkably resistant to corrosion, wear and shocks, the Rex Self-Priming Centrifugal Pump and the Rex Pumpcrete.

G. K. Vaill, a vice president, was elected to the vacancy on the Chain Belt Board, created by the death of Clifford F. Messinger. He has been with the company since 1921, serving successively as assistant to president, works manager, and vice president.

Arthur C. Rerick Now with Etnyre & Co.

E. D. Etnyre & Co., Oregon, Ill., announce the association of Arthur C. Rerick with the company as special representative. Mr. Rerick has had many years' experience in the pressure distributor, street flusher and street sprinkler business through his former connections with The Studebaker Corporation and Municipal Supply Company.